Aviation Week

Including Space Technology

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August 25, 1958

Navy Reveals How Submarine Fires Regulus II

Grumman Gulfstream Makes First Flight

First Flight Report on U.S. Turbine Helicopter

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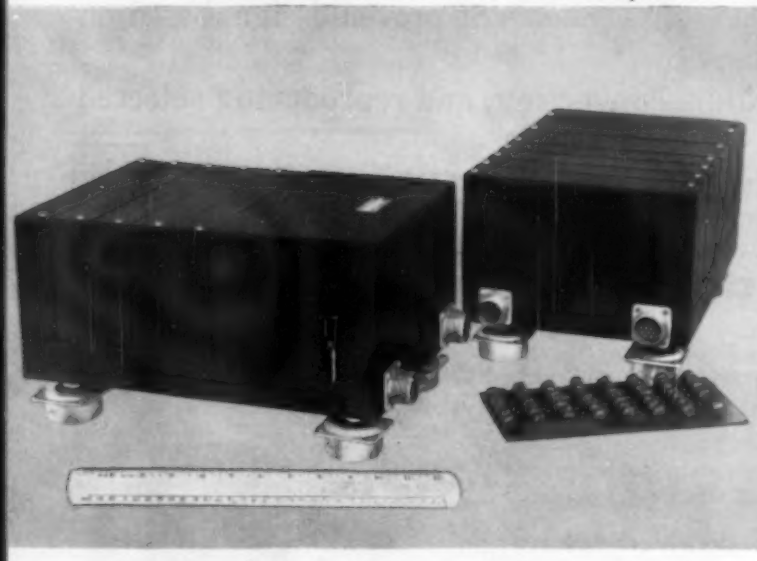

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AVIATION CALENDAR

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 4-6—AGARD Avionics Panel Meeting, Cambridge University, Cambridge, Eng.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 9-11—Second National Conference on Applied Meteorology: Engineering, Ann Arbor, Mich. Program Chairman: Dr. D. J. Portman, 5500 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 11-12—Annual Business Meeting and Conference, Northeast Chapter, American Assn. of Airport Executives, Municipal Airport, Worcester, Mass.

Sept. 15-18—Fall Meeting, American Rocket Society, Inc., Hotel Statler, Detroit.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International) Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Convention of the National Business Aircraft Assn., Bellevue Stratford Hotel, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 25-27—Fifth Annual National Western Forum, American Helicopter Society, Ambassador Hotel, Los Angeles, Calif.

Sept. 25-28—Air Force Assn. Annual Convention and Airpower Panorama, Dallas.

. . (*Continued on page 6*)

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August 25, 1958

Vol. 69, No. 8

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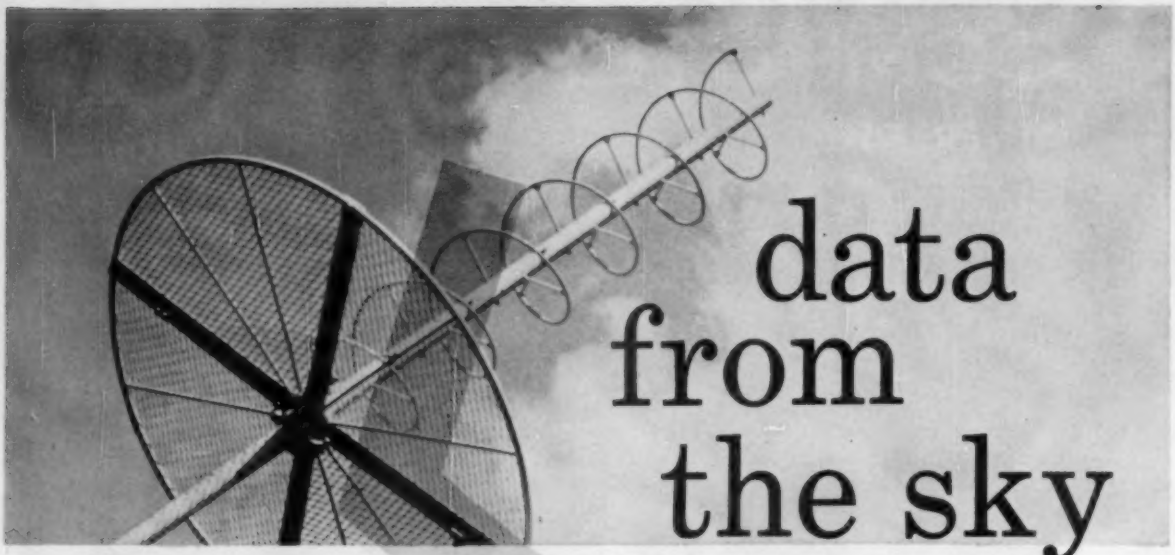

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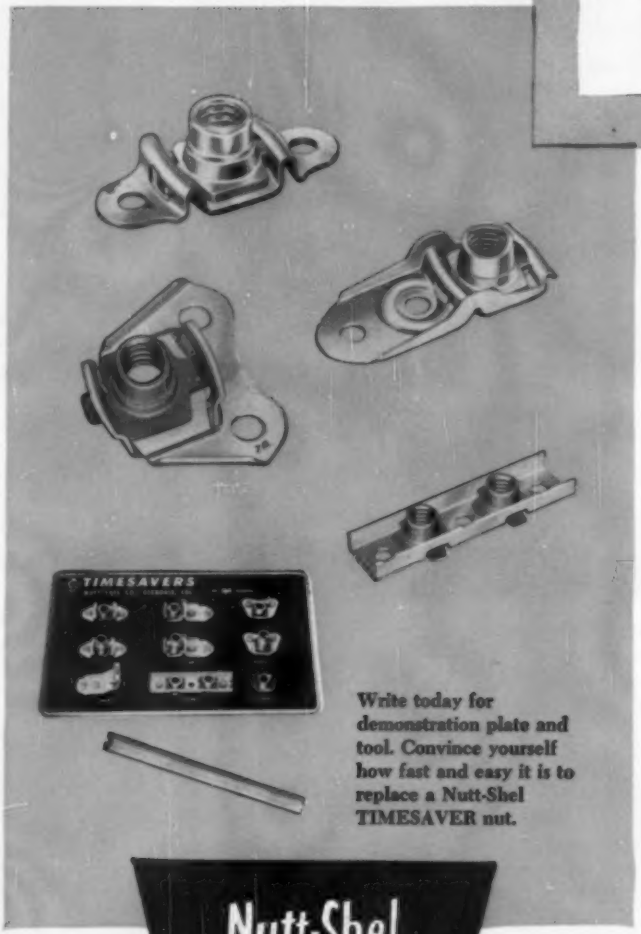

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Helon Carter's memo, dropped into the suggestion box at Convair, Ft. Worth, pointed out that many man-hours are required to replace those nuts which become damaged to the extent that replacement is necessary. "If," she said, "all 550° two-lug and one-lug floating nuts were replaced with plate nuts having removable threaded elements, replacement cost could be reduced. Records indicate that two men must now spend 10 minutes in drilling out the rivets of an installed nut, whereas one man can replace the nut element, if removable, in 5 seconds."

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AVIATION CALENDAR

(*Continued from page 5*)

Sept. 28-Oct. 2—114th Meeting, Electrochemical Society, Chateau Laurier, Ottawa, Canada.

Sept. 29-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles.

Sept. 29-Oct. 3—Semi-Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.

Oct. 1-2—Conference on Radio Interference Reduction, sponsored by Armour Research Foundation and U. S. Army Signal Engineering Laboratories, Museum of Science and Industry, Chicago, Ill.

Oct. 1-3—National Airports Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport Executives and the CAA.

Oct. 4—Second Annual Awards Banquet, Society of Experimental Test Pilots, Beverly Hilton Hotel, Beverly Hills, Calif.

Oct. 6-7—National Symposium on Extended Range and Space Transmission, sponsored by Institute of Radio Engineers and George Washington University, Lisner Auditorium, Washington, D. C.

Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.

Oct. 7-12—Sixth International Communications Convention, Genoa, Italy.

Oct. 8-10—14th Annual Aviation Spark Plug and Ignition Conference, Champion Spark Plug Co., Secor Hotel, Toledo.

Oct. 9-10—Ninth Annual National Noise Abatement Symposium, sponsored by Armour Research Foundation, Hotel Sherman, Chicago, Ill.

Oct. 13-15—ASME-ASLE Joint Lubrication Conference, Statler Hotel, Los Angeles, Calif.

Oct. 13-15—14th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 15-17—Twelfth Annual Meeting, Southeastern Airport Managers' Assn., The Palm Beach Terrace, Palm Beach.

Oct. 20-22—1958 Annual Meeting, Assn. of the United States Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 23-25—1958 National Simulation Conference, sponsored by Institute of Radio Engineers Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Tex.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 30-31—1958 Electron Devices Meeting, sponsored by Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

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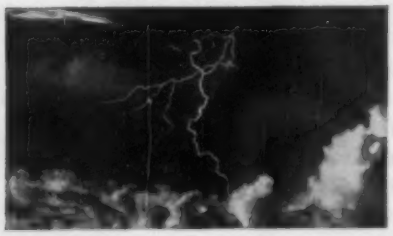
Precipitation static—ice crystals, snow flakes and rain droplets striking aircraft can cause crackling in headphones.

Static due to lightning discharges. These occasional bursts and crashes can be picked up at considerable distance. It is often your first indication of thunderstorm activity.

How to minimize static: Change altitude if it can be done safely. Decrease speed in rain or snow storms. Where possible, avoid dry snow and cirrus clouds composed of ice crystals. Keep radio volume turned low to reduce background noise. It is preferable to use a higher frequency broadcast station for ADF homing instead of low frequency range station. During periods of static, push headphones over temples when not listening—to keep fatigue to minimum.



Aurora Borealis, associated with magnetic storms. These extra-terrestrial phenomena cause communication fadeouts. Tune in to Time Signal Broadcasts of National Bureau of Standards (5 or 10,000 kilocycles for forecasts of periods of poor reception).

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Recruiting Pace Rises, Wescon Indicates 18
▶ Search for engineer services centers on high degree of capability, rather than former 'stockpiling' practice.

Airline Net Profits May Reach '49 Low 29
▶ Net profits of trunkline industry for first six months fall 76% below 1957 level.

Turbine Cuts Noise, Adds Power in S-62 64
▶ Prototype, currently powered by T58, also evidenced lack of vibration during flight evaluation.

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COVER: First flight of Grumman Gulfstream marks return of Grumman Aircraft Engineering Corp. to commercial field after nearly seven-year lapse. Last entry was Grumman Mallard amphibian, halted at outbreak of Korean War. Gulfstream has range of 2,200 mi. and will begin Civil Aeronautics Administration certification tests soon. Pressurized aircraft is designed to operate from runways under 4,000 ft.; fail-safe design concept is based on fatigue life of 25 yr. Company has 27 orders, will deliver first airplane in 1959. For additional flight photos, see page 26.

PICTURE CREDITS

Cover, 26—Grumman; 20, 21, 22—USAF; 21 (right)—Wide World; 24, 25—Northrop; 45—Chance Vought; 51—U. S. Navy; 53—Advanced Research Associates; 64, 65—Sikorsky; 72—Cessna; 77—Lockheed.

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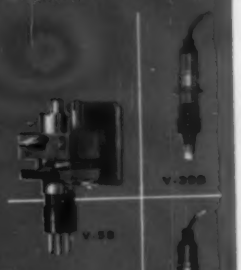

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EDITORIAL

First Shot at the Moon

The first U.S. attempt at lunar exploration launched from Cape Canaveral on Aug. 17 by the Air Force was a significant milestone in the exploration of outer space. Like all early experimental failures in attempts to pierce the frontiers of the unknown, it provided considerable knowledge with which to bolster the opportunities for success on subsequent attempts. First, it showed an amazing increase in technical capability by the USAF-industry team that was able to take a directive from the Advanced Research Projects Agency issued last March and translate it into a lunar probe ready to launch from a Cape Canaveral pad five months later at the exact time and date specified. Regardless of the failure of the probe in the air after launch, the feat of having it get off the pad at the exact pre-determined time is one that all technical people will appreciate.

Participants in this remarkable record include the USAF Ballistic Missile Division headed by Maj. Gen. Bernard Schriever; Douglas Aircraft Missile Division, which provided the Thor first stage; Aerojet, which built the second stage; Allegany for the solid propellant third stage; the Space Technology Laboratories of Ramo-Wooldridge, which had over-all technical cognizance of the program and development of controls for the second and third stages and development of the probe itself. This team was backed by a large number of components manufacturers and suppliers whose contributions also are vital to the success of any such major project.

The failure in the Thor first stage rocket engine appears to have been caused by a faulty fuel line. This is the type of random failure that is bound to occur ever so often regardless of the amount of systems testing that precedes a launch. But it also serves to recall the warnings Dr. Walter Dornberger, war-time commander of the German V-2 development program at Peenemunde, sounded early in our own ballistic missile development program. He pointed out that most of the early V-2 flight failures came, not from major systems, but from "two-bit" hardware such as valves, fuel lines, etc. which were not specially developed but taken off the shelf from normal industrial use. He pleaded for us to launch early in the game a special development program for minor hardware able to take the tremendous variety of stress and strain imposed during a ballistic missile mission. These type programs are now well along. But they did not come into being until we had suffered the same type failures of small components that plagued the V-2.

As a nation we have made great strides in organizing our military research and development program since the World War II days of the Air Corps Engineering Division at Wright Field and the Army Ordnance arsenal fiascos. But we still have a long way to go in laying a sound, broad foundation of basic research and then building effective organization to apply this new knowledge to military weapons development. Army, Navy, Air Force and the Department of Defense are all aware of this problem. They are striving, each according to his own bent, to formulate solutions. But the tangle of bureaucracy, timid technical leadership and bookkeeper control of research programs are still keeping this effort well short of its genuine technical capability.

Public reaction to the first moon probe failure also provided an interesting contrast to the hysteria that accompanied the first Vanguard abortive mission. Both the American public and the popular press, on which it depends for most of its information, have achieved a higher degree of understanding of the problem of experimental development. In this effort at better public understanding, top Pentagon officials contributed enormously by their candid pre-shot statements on the 10-to-one odds for success and by painting a realistic picture of the problems involved.

We heartily agree with Defense Secretary Neil McElroy's information philosophy on this matter when he explained:

"Under the American way, both successes and failures are reported candidly wherever and whenever possible. The public interest is paramount. This is in stark contrast to certain other areas of the world where only successes are reported, leaving countless failures concealed forever."

In this connection, AVIATION WEEK has been active in ensuring that Soviet failures both in their ballistic missile development program and in attempts to probe the lunar environment do not remain "concealed forever" (see page 23).

One aspect of this public information policy should be noted in passing as it is symptomatic of the type of "thought control" operation now being organized by a few Pentagon bureaucrats who would prefer the absolute government press control of "Pravda" and "Izvestia" to the American free, and often critical, press. This is the public rebuke dealt to Lt. Gen. Samuel Anderson, commander of the USAF Air Research and Development Command, for informing the American people of the correct date of the first lunar probe launching. The fact that this probe was actually launched on Aug. 17, the date specified by Gen. Anderson in his Milwaukee speech of June 10 (AW June 16, p. 292), and that official confirmation has now been given that another attempt will be made in September, as he said, is absolute proof of the veracity of his original statement.

The proximity of the moon to the earth and the period when the sun is in a position to light the backside of the moon for photography are matters of astronomical calculation as well known to the Soviets as to our own scientists. There was absolutely no shred of genuine military security in Gen. Anderson's statement.

Yet, his statement was first officially denied by Roy Johnson, head of the Advanced Research Projects Agency, who now emerges on the record as a source of dubious authenticity. Then, obviously at Mr. Johnson's petulant prodding, the Secretary of the Air Force, James Douglas, administered an official reprimand to Gen. Anderson for telling the American people the simple truth about a non-military scientific project of tremendous international import. It is indeed a sad performance. We do not think Gen. Anderson's stature has been diminished in the eyes of the American public because of the petty performance of his superiors.

But this incident is important to remember in view of the attempts now going on in the Pentagon to establish a form of censorship aimed at having only the "officially approved" viewpoint of the Defense Department reach the American public.

—Robert Hotz

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B.F.Goodrich aviation products

WHO'S WHERE

In the Front Office

C. A. Stillwagen, vice president-finance and treasurer, and **H. E. Ryker,** vice president-operations, Ryan Aeronautical Co., San Diego, Calif. Also: **B. K. Goodman,** secretary, and **M. K. Smith,** materiel director.

Dr. W. R. G. Baker, president of Syracuse University Research Corp., a director, Gulton Industries, Inc., Metuchen, N. J.

J. C. Mabe, a director, Chicago Pneumatic Tool Co., New York, N. Y. Mr. Mabe is vice president-plant operations.

Frank H. Erdman, president, U. S. Industries' Kett Technical Center, Inc., Pompano Beach, Fla.

Gerald T. Halpin, a vice president, Atlantic Research Corp., Alexandria, Va. Mr. Halpin continues as manager of operations.

Robert Erickson, executive vice president, Beckman Instruments, Inc., Fullerton, Calif.

Robert S. Levin, vice president-sales, Donallco, Inc., Sun Valley, Calif.

Donald J. MacFadgen, vice president-engineering, and **George Foster,** vice president-West Coast operations, Koehler Aircraft Products Co., Dayton, Ohio. **Harold A. Herkenhine** succeeds Mr. MacFadgen as chief engineer.

Walt Schindler, vice president-engineering, Vard, Inc., Pasadena, Calif.

Larry S. Winston, vice president-sales, Gilmore Industries, Inc., Cleveland, Ohio.

Aero Design & Engineering Co., Bethany, Okla., has announced: **Tom Harris,** in charge of the Sales Division, and **Julian Prade,** vice president of the newly established Military Relations Division.

Peter T. Craven, executive assistant to the president, AAXICO Airlines, Inc.

Capt. Edward W. Hribar (USN), has been assigned Deputy for Naval Applications, Aircraft Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission, Germantown, Md. Capt. Hribar also has been assigned as Director of the Nuclear Propulsion Division, Bureau of Aeronautics.

Honors and Elections

Dr. Anthony J. Cacioppo, the head of Goodyear Aircraft's Biomechanical Engineering Group, has been appointed to the U. S. Air Force sponsored Committee on Life Sciences of the National Academy of Science, Washington, D. C.

Dr. Walter P. Dyke, director of Linfield Research Institute, has been named recipient of the 1958 Electronic-Achievement Award, Seventh Region, Institute of Radio Engineers, "For his contributions to education and for his invention and engineering development in field-emission cathodes."

Robert L. Dickson, administrative vice president and controller of Walter Kidde & Company, Inc., has been elected president of Controllership Foundation, Inc., research arm of the Controllers Institute of America.

Dr. Clifford E. Berry, assistant director of research for Consolidated Electrodynamics Corp., has been elected chairman of the Gordon Research Conference on Instrumentation for 1959.

(Continued on page 81)

INDUSTRY OBSERVER

► Direct radio link between Washington and Pearl Harbor, Hawaii, will be provided by Navy's new moon-bounce communications system now being installed. Navy expects to achieve a range of about 5,000 mi. by using moon as a passive relay. System will provide one voice channel or several teletype channels (AW May 12, p. 32). It will employ 84 ft. diameter antennas made by D. S. Kennedy & Co., which will be similar to those employed for radio astronomy.

► Air Force will soon call for industry bids for development of a bomber launched medium-range ballistic missile. Companies selected to bid reportedly include Bell Aircraft, General Electric, Martin and North American. Bell and General Electric may submit a joint team proposal.

► Complete telemetry records from launch to splash were obtained on the mice carried in the last two Thor-Able firings. Record of mouse's heartbeat in third firing matches acceleration telemetry records to one thousandth of a second, showing that the mouse served as a living accelerometer. Mice were incidental to main purposes of Thor-Able–lunar vehicle checkout and nose cone experiments–but produced useful information even though they were not recovered from the sea. USAF used Navy-developed telemetry to obtain readings on the mice.

► Static testing of Titan engines at Cape Canaveral, Fla., will be done in sequence to simulate mid-air lightoff of second engine. Larger first stage is placed in tallest of two fold-down gantries. Immediately next to it is second stage in smaller fold-down gantry. Stages are electronically connected so that second engine fires after first stage has fired and simulated coasting time has elapsed. Blockhouse also is two-level, unlike the single-level Atlas blockhouses.

► Number of reorganization changes are in the wind for General Electric's Defense Electronics Division. Most significant will be the formation of a weapon system management department to enhance GE's ability to get major weapon system contracts and to better integrate efforts of individual de-centralized departments. Responsibility for space vehicles will be assigned to Missile & Ordnance Systems Department, presently building nose cones for Atlas and Thor ballistic missiles.

► Navy is evaluating the Sud Alouette turbine helicopter for possible use off destroyers as an anti-submarine warfare weapon. Navy eventually hopes to extend concept of using small helicopters off destroyers to incorporate employment of pilotless rotary-wing vehicles for both hunting and killing submarines. Technique could extend a destroyer's present ASW kill capability by hundreds of square miles. Alouette is being built in U. S. under license by Republic Aviation Corp.

► Guidance system for production models of Navy's Polaris fleet ballistic missile is expected to weigh one-seventh as much as similar systems designed for already-developed land-based intermediate range ballistic missiles. Polaris' guidance is being developed by Massachusetts Institute of Technology and General Electric.

► Polaris test vehicle is dynamically unstable to provide extreme test of effectiveness of Jetavator thrust vectoring rings. Of 22 firings to date, 16 are said to be completely successful, five partially successful and one unsuccessful.

► "Solid" gasoline reportedly is in an advanced stage of development by the Fuel Institute of the Soviet Academy of Sciences. Liquid gasoline is mixed with plastic pulps to form a thick paste of 95% gasoline which is shaped into bricks. Bricks are wrapped in a special film to prevent evaporation. Primary purpose of the solid form of gasoline is to improve its transportation qualities and reduce the possibility of explosion. Liquid gasoline may be obtained from the "bricks" by subjecting them to pressure.

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Washington Roundup

Procurement Studies

House and Senate Armed Services Committees and Defense Department will make comprehensive studies of the military procurement system to pave the way for action on legislation early next year when the new Congress convenes. Moves in this direction include:

• **Sen. Leverett Saltonstall (Mass.)** high ranking Republican on Senate Armed Services, asked Committee Chairman Sen. Richard Russell (D.-Ga.), to direct the staff to make a research and evaluation study on legislation he recently introduced that would expand use of the "weapon system" and fixed-price incentive-type contracts and decentralize military supervision of research and development contracts (AW Aug. 18, p. 26). He has asked the Secretary of Defense and the three service secretaries to have their staffs do the same. Saltonstall plans to review recommendations made as a result of these studies and introduce revised legislation in January.

• **Staff of the House Armed** Services Investigating Subcommittee shortly will complete its investigation of military procurement with emphasis on "weapon system" contracting. The group's chairman, Rep. Edward Hebert (D.-La.), plans hearings in mid-November. Members of the subcommittee have been antagonistic toward the weapon system and the extensive use of negotiated contracts. The group has consistently urged greater use of formal advertised bid contracting.

Defense Funding

Legislation which in its original form threatened to throw up new defense funding roadblocks by putting both new contract money and expenditures for production and research and development on a year-to-year basis was so watered down in the version finally passed by Congress that it is expected to have little, if any, effect. As sent to the White House, the measure provides:

• **That full-funding, as at present,** shall be continued for military production and research and development. In the original version, long-term projects would have received piecemeal financing year by year from annual congressional appropriations.

• **That the President may recommend and** the Congress set an annual ceiling on Defense Department spending. The ceiling is permissive. Under the original measure, the firm ceiling, established by law, would have been required. Members of House Appropriations Committee emphasized the impossibility of establishing a realistic ceiling a year in advance.

CRAF Negotiations

Air Force Secretary James H. Douglas met with commercial airline officials last week in a move to reach an agreement on the proposed standby contracts covering the Civil Reserve Air Fleet (CRAF). No decisions on the terms of the contracts were made during the Pentagon meeting but both Air Force and the airlines agreed to resume negotiations on Aug. 26.

Until this meeting, little or no action had been taken on the proposed contracts during the past three years, although the airlines have been prepared to turn over the fleet to the Defense Department in the event of an emergency without the benefit of contracts. Last month, Stuart G. Tipton, president of the Air Transport Assn., charged that the Air Force had failed to act on the standby contracts despite the fact the airlines have consistently shown a desire to settle the issue.

Meanwhile, the ATA reported that some 70 million passenger miles of airlift were offered the military by the U. S. scheduled airlines in response to an Air Force canvass following the Mid East crisis last month. ATA said that enough air service to fly more than 12,000 personnel to Lebanon was offered the Air Force and that the airlift could have been placed into operation immediately without interrupting regular civilian service.

Defense Committee Cut

Defense Department on Sept. 1 will abolish another 59 of its coordinating committees, cutting the number from an original 299 to 101. Defense already had eliminated 133 committees (AW July 7, p. 25) and deleted others from the list by ruling that they were "found not to be Joint Department of Defense committees."

The cuts were made on orders of Defense Secretary Neil H. McElroy in an effort to accelerate the decision-making process within the department. Next step will be to review Defense Department representation of interdepartmental and international committees.

Renegotiation Outlook

Congress last week appeared set to extend the renegotiation law by six months—to Dec. 31. The House and the Senate Finance Committee voted the six-month extention. They also extended the law to include contracts let by the new National Aeronautics and Space Administration. The White House had wanted a two-year extension of the act.

W. M. Allen, president of Boeing Airplane Co., speaking for Aircraft Industries Assn., led the opposition to the law in testimony before House Appropriations Committee (AW Aug. 18, p. 27). Robert Dechert, general counsel of Defense Department, presented the Administration's support for the measure.

Post-Contract Analysis

Air Force is giving "serious thought" toward establishing criteria for a post-contract analysis of profits to determine how well a company accomplished "what they agreed to at the outset," according to Lt. Gen. C. S. Irvine, deputy chief of staff for material. The analysis would include an evaluation of management and hardware performance and be used in establishing a firm's eligibility for incentive profits. Gen. Irvine says it might also be used in subsequent reviews of the contract by other authorities, including the Renegotiation Board.

Controller Hesitancy

Civil Aeronautics Administration is becoming concerned over the unwillingness of some of its best air traffic control trainees to assume full responsibility. While CAA has avoided public expression of this concern, spokesmen say that many of the best qualified students have refused promotion from assistant to chief operator when it was offered because of the added workload and responsibility. Under present Civil Service criteria, they say, this complicates the problem of filling top controller jobs, since the assistant operator can elect to remain at the lower grade while blocking other aspirants.

—Washington staff

THE PLASMA JET—

a case of research and advanced development

Development of a re-entry simulation facility for the Air Force *Titan* ICBM nose cone required a method for heating air to extremely high temperatures. A special type of electrical discharge, sometimes called a "plasma jet," was considered. Both *fundamental* research—to obtain a quantitative understanding of the arc properties and mechanism—and *applied* research in actual aerodynamic and materials testing were needed. Advanced development—the actual design and construction of improved test facilities—was also an inherent part of the problem.

Theoretical and experimental physicists, aerodynamicists and physical chemists began a simultaneous attack on the fundamental processes. At the same time, and in close association with the others, instrumentation and mechanical engineers began to build and use a series of continually improved facilities for re-entry testing. Those inclined toward either fundamental or applied research in their particular specialty were able to maintain their integrity and their own research approach. At the same time they were able to benefit from the close working association with one another.

The results were especially fruitful. The plasma jet has proven an excellent tool for re-entry studies. Investigations of important applications in high-temperature chemistry, space propulsion and refractories are following as an added bonus.

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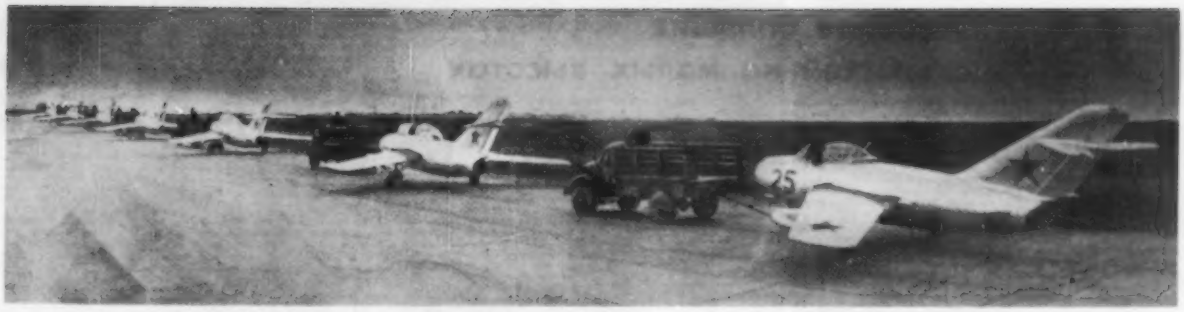


Russian Contrast: Trucks Tow MiG-17s

Sharp contrast in Russian concept of air age modernization is illustrated above as some of Red Air Force first line jet fighters, the MiG-17s, are towed down a runway by World War II trucks. Note men riding on truck beds, probably to aid in tow guidance.

Space Technology

NASA Budget Cut $45 Million By Conferees of House-Senate

Washington—House-Senate conferees last week voted a $45 million cut in the first-year budget for the new National Aeronautics and Space Administration—despite the persistent calls on Capitol Hill for a bolder space program.

NASA asked for $125 million. The conferees agreed to $80 million, and the House concurred.

Meanwhile, the Senate unanimously confirmed the nominations of T. Keith Glennan as NASA administrator, and Hugh L. Dryden, as deputy administrator (AW Aug. 18, p. 28).

Previous to the conferees' action, the Senate had approved the full $125 million asked by NASA. Supporting this on the Senate floor, Sen. Lyndon Johnson (D. Tex.), majority leader and chairman of the Senate's Special Space and Astronautics Committee, said:

"The $125 million appropriation request, which was a very modest one, and, we thought, considerably lower than it should have been, came only after careful planning and programming under the direction of the President (AW Aug. 11 p. 18).

"The program has been laid out in detail and represents an integrated and balanced approach to the agency's immense new responsibilities."

Here's how the conferees' cut was distributed:

- **Salaries and expenses, $2 million.** The conferees approved $5 million of the $7 million asked.
- **Research and development,** $20.02 million. They approved $50 million of the $70.2 million asked.
- **Construction and equipment,** $22.8 million. The conferees approved $25 million of the $47.8 million asked.

In addition to its direct appropriation, NASA will have $218 million for its first-year financing: $117 million in funds transferred from Department of Defense and $101 million appropriated for National Advisory Committee for Aeronautics, predecessor of NASA.

Defense Department has earmarked $294 million for the space activities of Advanced Research Projects Agency.

Doppler-Inertial System Navigates Convair B-58

Doppler-inertial navigation system for Convair B-58 Hustler automatically navigates bomber and controls release of its 50-ft. bomb pod. Recent tests of AN/ASQ-42 aboard B-58 at supersonic speeds indicate new Sperry-developed system is 10 times as accurate as present operational systems, company says. Use of inertial navigator instead of surveillance radar enables B-58 to approach target without revealing its presence to enemy reconnaissance receivers. Doppler radar is used to correct for inertial component errors until bomber approaches enemy territory. Gyro-stabilized platforms for B-58, shown under test at left, also provide signals to other avionic equipment on board. Sperry says B-58 system weighs 20% less, occupies 37% less volume than former systems.

Recruiting Pace Rises, Wescon Indicates

Search for engineer services centers on high degree of capability rather than former 'stockpiling' practice.

By James A. Fusca

Los Angeles—Engineers at the Western Electronic Show and Convention here are discovering that the intense competition for their talents between companies throughout the avionic and electronic fields is back again, hotter perhaps than the highest levels of two years ago.

Competition is not the search for warm bodies of past years for stockpiling purposes or "to demonstrate a capability." Rather, it shows marked emphasis on a high order of ability. One of the more important effects of the past year's business upheavals has been to give companies a greatly increased consciousness of the need for quality in engineering personnel.

A survey of representative companies in the industry made by AVIATION WEEK indicates that personnel departments may be making major modifications in their offensive and defensive tactics over the coming year. Trends affecting recruiting are:

• **Average engineer** in the avionic and electronic fields, six years out of school, today is earning $10,000 per year. The above average engineer is earning about $12,000 and the below average engineer about $8,000. Demand for the superior engineer never decreased; any who lost jobs in drastic program cutbacks were offered others.

The supply of average engineers appears to be drying up fairly rapidly. Marginal quality engineers will find it increasingly difficult to migrate from one job to another as in the past.

• **Engineering management** is making an increasing effort to keep high potential personnel. To do this, salary policies are being revamped to provide growth rates larger in some cases by a factor of three than for salaries paid to "average" engineers.

The days of "firefighting" salary policies—where a valued engineer would be offered a significant salary increase only when he attempted to resign—appear about over. Also, more attempts are being made to place these engineers in the type of projects they most enjoy. These policies are paying off in reduced turnover of key personnel.

• **Most mobile people** in the present labor market, those most willing to change jobs, are the average engineers who have been out of school for several years and are finding their salaries squeezed between the yearly rate at which their salaries increase and the steadily increasing starting salaries being paid more recent graduates. Company managements say they expect fairly high attrition at this level as the price of maintaining acceptable wage scales.

Unanswered Questions

One of the unanswered questions of the present recruiting situation is where the large numbers of senior personnel being sought will come from. Increases in engineering staff desired by companies recruiting here average 20% over the next four months. The situation, in the opinion of many recruiters, is already far more competitive than ever before because the group with high qualifications being recruited is far smaller than the engineering pool that was being recruited two years ago.

Among the questions asked recruiters and company officials and the answers given were the following:

• **When asked** if their company's recruiting efforts had been stepped up during the last six months, 90% said "yes." The remaining 10% said that the level of effort was about the same, that it had never slowed down.

• **Asked if the available** supply of engineers had tightened up during this period, more than 50% said "yes" while the remaining companies explained that they were being more particular or seeking specialists who were definitely in short supply.

Electronic and avionic engineers are most scarce, especially those high level engineers with broad backgrounds in research and development. Companies seeking engineers for work on guidance systems, computers, aerodynamics and structures said they were having difficulty. Physicists, also, and others with training in the fundamental sciences, are hard to find.

All companies contacted said that they have not lowered their hiring standards either as to experience or quality as a means of acquiring additional engineers. About 10% said that, rather than lowering their standards, they had raised them and were seeking higher quality personnel.

When asked if salary offers had been raised over the six months period, companies divided about equally—50% saying absolutely not and the others answering with a qualified yes.

Qualifications ranged from saying that the trend was definitely upwards to one company that stated it would pay whatever additional increase was necessary to obtain the help it needed. The average increase was 5%.

In discussing the number of engineers that they would like to hire over the next four months, some of the largest companies named figures beginning at 350 to a high of 1,500 of which approximately 85% would be avionic or electronic engineers.

Most companies wanted experienced engineers, although one or two smaller companies said that they would hire junior engineers for on the job training.

The increase in engineering staff represented by these figures averaged 20%. Smaller companies fell in the group from 10% to 20% while, with one notable exception, the larger companies planned increases from 20% to as high as 40%. In the case of the larger companies, the figures obtained were for the specific divisions working in the fields of electronics, aviation, missiles and ground support equipment.

Opinions differed widely on whether the spokesman's own company had suffered increased attrition due to competitive recruiting during the last six months. While no two answers were exactly the same, they varied from a hopeful "no" to a somewhat angry "yes." Some noted that increased attrition was limited to the electronics and avionic personnel.

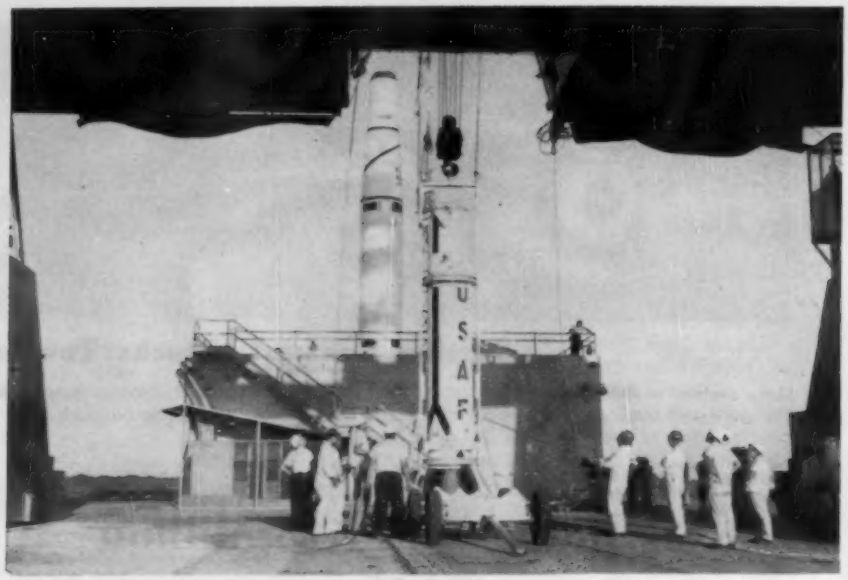
ARDC Static Stand

Wright-Patterson AFB, Ohio—Air Research and Development Command reported last week that construction of the world's largest and quietest static test stand for turbojet engines has been completed at Wright Air Development Center. New stand is designed to test 60,000 lb. thrust engines and to move 2.5 million cubic feet of air per minute.

Specifications call for the noise level outside the test stand to be only 1/1,000th of that inside the stand. Air intake and exhaust for the installation are 45 ft. wide and 80 ft. high. It will be used for testing fuels and lubricants as well as jet engine development and calibration. Contractor for the test stand was George W. Timmons of Columbus and Dayton, Ohio.

Packaged Liquid Order

Denville, N. J.—Navy has placed first order for prepackaged liquid propellant rocket engines with Reaction Motors Division of Thiokol Chemical Corp. Order is for thousands of Reaction Motors' Guardian engines which will probably be used in Sparrow III air-to-air missiles.



TECHNICIANS erect modified Vanguard second stage prior to mating it with first stage Thor (above) for first lunar probe shot. At left, complete vehicle leaves launch pad.

First U.S. Lunar Probe Fails

By Evert Clark

Cape Canaveral, Fla.—First U. S. lunar probe test vehicle had executed a difficult roll and turn and was performing perfectly last week until an apparently random failure caused an explosion that ripped apart the Thor first stage engine after 77 sec. of flight.

Despite the early failure, engineers on the project took some satisfaction from these points:

• **Difficult task of launching** a liquid fueled rocket precisely at a time set some weeks earlier was almost achieved. Target time was 7:14 EST Aug. 17. Launch time was 7:18 EST, and the four minute delay was caused by radiation interference from a source outside the Air Force Missile Test Center.

• **Roll programmed into the flight** and successfully executed was of greater magnitude than any so far on a Thor-Able shot. Telemetry data indicated that the control system, in which some changes had been made since the last previous flight, worked well.

• **Telemetry records confirm** that the flight was going perfectly until the explosion. Maj. Gen. Bernard A. Schriever, commander of Air Research and Development Command's Ballistic Missiles Division, said immediately after the flight "everything was perfect up to that particular point."

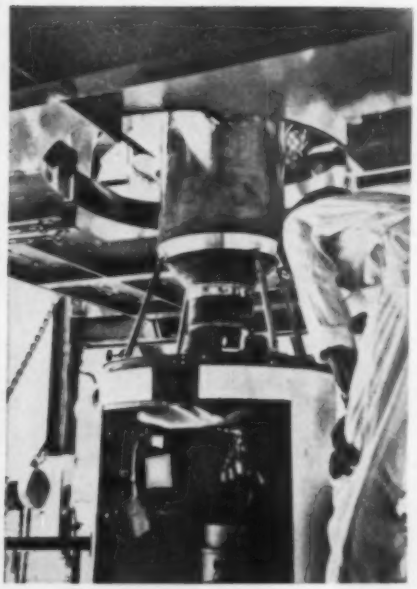
USAF plans to attempt a second lunar probe launching in the four-day period beginning Sept. 14. Thor first stage already is at Cape Canaveral. Payload of the Pioneer satellite that could attain an erratic orbit around the moon probably will be the same as that used in the first try.

Explosion occurred at approximately 50,000 ft. and approximately 10 mi. at sea exactly 77 sec. after launch, or 80 sec. short of burnout of Thor's Rocketdyne engine. Suspected cause of failure was a ruptured JP fuel or liquid oxygen line.

By late last week only pieces of tankage and skin had been recovered by divers. Upper stages may have remained fastened together. Erratic telemetry signals from upper stages and payload were received for approximately 123 sec. after the explosion and upper stages were tracked all the way to impact with the ocean.

The Rocketdyne engine, first off the production line at the Neosho, Mo., plant, was not static tested at Cape Canaveral. Neither were the first stage engines in the last two of the three Thor-Able shots that preceded the lunar vehicle. Lunar vehicle was designated Able I.

Schriever said a ruptured fuel or liquid oxygen line would be considered a random failure that could not have been predicted. Static testing might not have produced the same failure that the stresses of actual flight did and also might have caused other damage, Rocketdyne spokesman said. Next lunar shot also will use a Neosho engine..



VANGUARD second stage utilizing Aerojet-General liquid propellant engine is linked with Thor primary stage at left. Second and third stages are joined at right.

After Promising Launch

The 53-ton Able I was launched at an angle of approximately 22½ deg. north of the equator, the most northerly angle for any firing along the Atlantic Missile Range except for the recent launching of Explorer IV at 51 deg.

Even the achievement of free flight was considered unlikely. Douglas Thor, used as the first stage, has had 13 successful flights out of 18 launches. Schriever said the engine ran to burnout in six of the last seven launches, which included the three Thor-Able shots.

The 7,500-lb. thrust Aerojet-General second stage engine has been fired in flight four times in the Vanguard satellite vehicles and has been used as the second stage in the three Thor-Ables. In at least two of the Thor-Ables it performed perfectly.

In the Vanguard, the Aerojet engine is credited by Navy with three successful firings out of four tries. On one shot it performed successfully. On another, it did the same but two electrical relays failed, and the third stage was not signaled to fire. On another, cutoff came too late, putting the vehicle at too high an injection angle for an orbit. On the fourth, the engine cut off prematurely and terminated the flight.

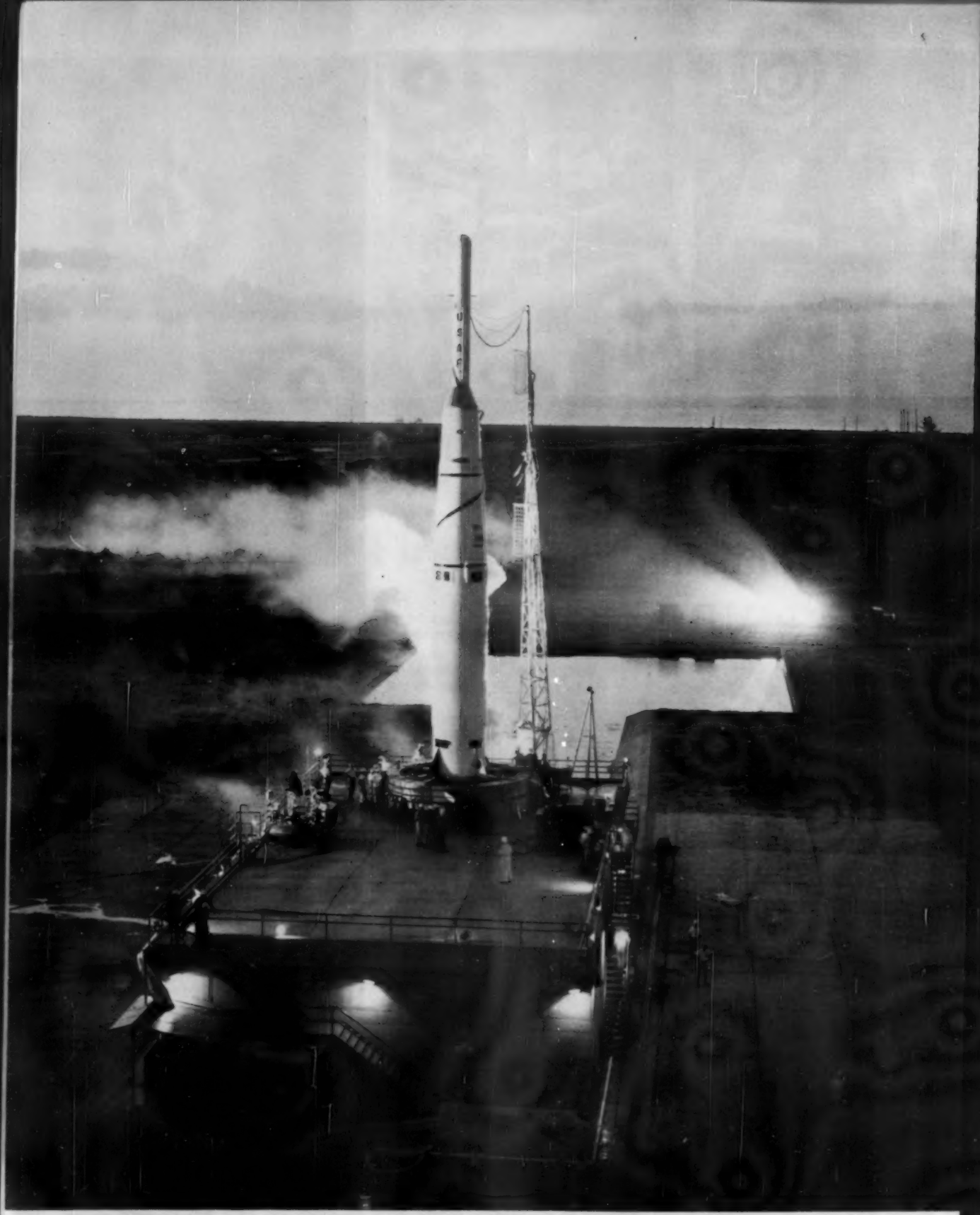
Schriever said the control system for this stage has been "changed very considerably" from the Vanguard configuration.

Allegany Ballistic Laboratory's 2,500-lb. thrust third stage engine for Able II never has been fired in flight but has been static tested at Arnold Engineering Development Center. Fourth stage engine, a 3,000-lb. thrust rocket surrounded by the toroidal payload unit and pointed upward at the time of launch, is a Thiokol engine similar to those in the Falcon missile.

If the vehicle had performed successfully, both the second stage and eight spin rockets were to fire immediately after separation of the first stage. After the second stage burned and separated, an aerodynamic firing covering the third stage payload was to drop

RETROROCKET is visible in top of opened instrument package. Eight vernier rockets for terminal velocity and vector control are attached at the base. Instrumentation visible inside includes TV scanner.

THOR-ABLE rocket exploded shortly after the lunar launch at Cape Canaveral. Vertical streaks and white dots are pieces of rocket flying away from the explosion.



SPACE AGE DAWN --Liquid oxygen vents from Thor-Able I lunar probe vehicle as firing time nears at Cape Canaveral, Fla.

Soviet Moon Shots

Washington—Soviet Russia has failed in four or five attempts to send rockets to the moon. One rocket contained a nuclear warhead and was intended for a direct strike on the moon's surface.

Russian moon rocket failure reported by Aviation Week last Aug. 4 (p.26) apparently was the fourth attempt.

First Russian shot, containing the nuclear warhead, was fired last year shortly after Sputnik I was placed into orbit. Attempts were to have been made to photograph the nuclear explosion on the moon for propaganda purposes.

Shots occurred fairly regularly after that. One was made early in January, another in March, another on May 1 and the last in July.

Some of the later shots may have been of the orbital type similar to that attempted unsuccessfully by the U. S. on Aug. 17. These require less precise guidance than an impact shot.

Strong criticism by scientists of proposals to explode nuclear weapons on the moon's surface may have convinced Soviet leaders that the propaganda loss following such a stunt would be greater than the gain.

U. S. Army's first moon shot attempt, due later this year, will be an impact shot but will not include an explosive.

away. Third stage was to burn and then coast while readings were taken on velocity and direction for a period of five or six minutes. Then, several pairs of vernier rockets were to be fired in an attempt to improve the velocity vector.

The Fiberglas payload unit, weighing 85 lb. and carrying 25 lb. of instruments, would have traveled until a signal from a tracking station at Hilo, Hawaii, fired its terminal rocket at some 200,000 mi. from earth in an attempt to put it near enough to the moon that it would be pulled into some kind of orbit. Series of erratic orbits might have lasted up to a week. Chemical batteries in the spinning satellite would have lasted approximately two weeks.

Payload Package

Payload package contained:

- **Magnetometers for measuring** magnetic fields of earth, space and the moon at high and low amplitudes.
- **Instruments for measuring** micrometeorite impact, internal temperature of the whole unit and chamber pressure of the terminal rocket to indicate whether it fired.
- **Infrared-television scanner** to obtain crude pictures of the moon's surface.
- **Batteries and telemetry equipment** for broadcasting on 108.03 mc., the International Geophysical Year frequency.

Determination of whether the moon has a magnetic field probably will be more important than obtaining pictures of the moon's far side, which is expected to look like the side that always faces the earth. Theories of the cause of earth's magnetic field may be clarified by investigation of magnetic fields that may lie near the moon or between earth and moon.

Launching of Able I and the two remaining USAF moon probes in operation Mona are under the direction of Defense Department's Advanced Research Projects Agency. Program is monitored by USAF's Ballistic Missiles Division. Space Technology Laboratories of Thompson-Ramo-Wooldridge Corp. is the prime contractor. The probes are on an IGY program.

Space Technology Laboratories, soon to become a separate organization (see page 24), handled over-all technical direction and systems engineering, development of components and subsystems and development and hardware responsibility for the second and third stages and the payload. It also supervised establishment of the tracking network and handled data reduction.

Fifty-two industrial and scientific firms are involved in the project, 46 of them in the Southern California area, one in Northern California, two in Illinois and three on the East Coast.

Principal Subcontractors to Space Technology Laboratories are Hallamore Electronics, Atlantic Research Corp., Pacific Automation Products, Rantec Corp., Revenes Instrument Corp., Summit Industries, Western Electric and Radio Corp. of America.

Tracking network includes five primary stations at Hilo; Manchester, England; Millstone Hill, Mass., Singapore, Malaya; and Cape Canaveral.

Nine Minitrack satellite tracking stations complete the network. Main stations send "quick-look" data to BMD-STL's data reduction center at Inglewood, Calif., by teletype and store telemetry data on magnetic tape.

Space Technology Laboratories project director is Dr. George E. Mueller, BMD project director is Col. D. R. Latham. For the first launch, test director was Miles Ross of STL; test conductor was Ted Gordon of Douglas and test controller for BMD was Capt. Brandy Griffith, project officer for the complete Able program.

Space Technology

Gen. Irvine Details Guidelines For Contractors in Space Age

Salt Lake City—Ability to produce low-cost hardware with high performance and reliability will largely determine the economic well being of individual aviation companies as the Air Force moves further into the space age.

This warning that industry must become increasingly performance and cost conscious was delivered by Lt. Gen. Clarence S. Irvine, deputy USAF chief of staff for materiel, at the dedication of a new Litton Industries facility here.

Irvine added:

"In the past, we have used such techniques as failure-feedback reporting followed by retrofit programs to make up for shortcomings in reliability and durability. These procedures worked fairly well with long production runs —although in the end they were unreasonably expensive.

"In the future, however, when short production runs will be the norm, backtrack corrections will be totally unacceptable. This means that full-time, maximum performance capabilities must be designed, developed and produced into first and subsequent items. We cannot waste time and money building complete prototypes of complete weapon systems just to prove out the accuracy of our engineers' calculations.

"Functional reliability and structural durability should be virtually 100%. If components and parts cannot provide performance above minimum specs under the most severe conditions, they will be considered as not being acceptable.

Gen. Irvine also complained that "it seems that" every time the performance of an electronic component or subsystem is improved "prices skyrocket—all too often at a disproportionate rate."

"The point is," he added, "the Air Force is going to be more and more cost conscious as we move into the space age. Neither complexity of equipment nor international tension justifies exorbitant pricing patterns.

"The industry as a whole can take this as a not very subtle hint. The dollar criterion will be applied more and more as a measuring device in awarding development and production contracts."

Gen. Irvine said progress payments will continue to be relatively lower percentage-wise than in the past. This means, he said, that industry will be forced to see that scheduled deliveries and billings are more current and more accurate than at present in order to avoid excessive borrowing of capital at commercial interest rates.

Space Technology

Ramo-Wooldridge to Sever Ties With Space Technology Division

Los Angeles—Ramo-Wooldridge Corp. has moved to sever all operational control and ties with its former Space Technology Laboratories division with the announcement that Gen. James H. Doolittle will become Board Chairman of the latter on Jan. 1 and that all Ramo-Wooldridge representation on the board of directors will be withdrawn shortly afterwards.

However, Ramo-Wooldridge and Thompson Products, with which it plans to merge (AW July, p. 28) retain full ownership of Space Technology Laboratories and have no plans to dispose of these holdings, an official told AVIATION WEEK.

Space Technology Laboratory serves as technical consultant to Air Force on its ballistic missile programs and several space technology projects, including the lunar probe program.

Dr. Simon Ramo, president of Space Technology Laboratories, will return to his former post as executive vice president of Ramo-Wooldridge after a short transition period. He will be succeeded as president by Dr. Louis Dunn, currently executive vice president and general manager of Space Technology Laboratories. Reuben Mettler will succeed Dunn as executive vice president of Space Technology Laboratories.

Move to establish Space Technology Laboratories as a completely separate operation stems in part from a mutual desire on the part of the Air Force and Ramo-Wooldridge to divorce STL's technical management efforts from Ramo-Wooldridge's own activities in the aviation-avionics field. Under the original terms of the Air Force contract, Ramo-Wooldridge was excluded from participating as a manufacturer in any of the USAF ballistic missile programs on which it was serving as a technical advisor.

The latest move follows earlier partial steps which saw Space Technology Laboratories established first as a separate division, later as a separate corporation, but with Ramo-Wooldridge representation on its board of directors. Under the new arrangement, Ramo-Wooldridge and Thompson Products will receive only financial data on STL operations as the sole stockholder but will not have access to non-financial data, a Ramo-Wooldridge official says.

As a separate corporation, Space Technology Laboratories will have total assets of around $20 million, net assets of about $12 million. Annual income at present rate will total about $40 million.

Company will employ around 2,500, including approximately 800 engineers and scientists. This will leave Ramo-Wooldridge with total employment of around 1,500, including approximately 400 engineers and scientists.

Space Technology Laboratories will not be operated as a non-profit organization. A Ramo-Wooldridge official says it will be expected to show a modest return on its owner's investment.

Gen. Doolittle will retire as vice president of Shell Oil Co. before assuming new duties, but will remain on the Shell board of directors.

House Group Criticizes USAF, Navy Buying

Washington—Air Force and Navy were criticized for not buying an adequate quantity of seven-round rocket launchers and for shifting procurement to a 19-round launcher in a report released last week by the House Government Operations Committee.

Later, Centuries Industries, a San Pedro, Calif., firm which manufactured the seven-round launchers for both services, went out of business.

Because "the Air Force still has no production from its contract for the 19-rounder and the Navy only a limited quantity," the committee declared there is an "imbalance" between rockets and launchers. "Were an emergency to arise," it added, "the total firepower capabilities of Air Force and Navy air-

Northrop Rolls Out Area-Ruled T-38 Supersonic Trainer

Northrop Aircraft, Inc., has rolled out its first USAF T-38 supersonic jet trainer four days ahead of schedule at Hawthorne, Calif., plant. Area-ruled trainer, which will be evaluated by Air Training Command, is powered by two General Electric J85 turbojet engines producing 2,500 lb. thrust each. Aft section of T-38 is detachable to permit engine installation and removal; each engine has overhead track and roller arrangement to facilitate handling. Controls are hydraulically powered. Designers have stressed maintainability (AW Jan. 13, p. 51) and safety. Northrop N-156F fighter is under parallel development.

craft would be substantially reduced by the lack of launchers." USAF's excess rockets, the committee said are being used "for proficiency training with dummy heads." USAF's contract for the 19-round launchers is with Chromcraft Corp., St. Louis, Mo.; Navy's with the Be-Ge Co., Gilroy, Calif.

The committee contended that "the Air Force could have hedged against the risk of an extended waiting period for the new 19-round launcher by quickly augmenting its inventory of seven-round launchers."

The report, which is based on a two-year investigation of the launcher program, said:

"Centuries Industries declared itself ready and willing to organize speedy production. In several meetings between company and Air Force representatives, price terms, accelerated delivery dates, material supply factors and other matters were discussed. The Air Force did not follow through on its negotiations and Centuries Industries went out of business . . .

"In rejecting Centuries Industries' offer and deciding to discontinue procurement of the seven-rounder, the Air Force left itself unnecessarily exposed to the risk of an emergency in which the supply of launchers would be severely limited. . . ."

Navy's reason for switching from the seven-rounder to the 19-rounder in order to achieve "the long-sought goal of inter-service compatibility of airborne rocket launchers" was challenged.

"While the suspension systems of aircraft in both services can be used interchangeably to mount the 19-rounder," the committee declared, "other design modifications make the Navy launcher unsuitable for the Air Force."

The committee added that "an inexpensive adapter device designed by Centuries Industries and costing less than $5 could have been used to make the same seven-round launcher usable on both Navy and Air Force aircraft."

Air Force reduced its requirement for launchers from 43,750 in January, 1957, to 20,767 in March, 1958. Although only a third of the 44,263 launchers the Navy ordered in June, 1956, have been delivered, the committee reported that "Navy witnesses, speaking in the same vein as the Air Force, declared that changing tactical requirements make this retarded delivery schedule acceptable. They also said that the number of planes using this equipment has been reduced."

De Havilland Designs Dual Spectre Rocket

London—De Havilland Engine Co. Ltd. has developed a double Spectre liquid propellant rocket motor combining a fixed thrust Spectre 4 unit mounted above a variable thrust Spectre 5 unit. Development of this missile and a manned interceptor propulsion installation has been proceeding since late last year, the engine company disclosed.

As both rocket units have been separately developed over the last five years, the combination posed no special problems and passed a special category flying test a few months after the design was completed.

Both Spectres can be brought instantaneously up to full thrust and either may be shut down. The variable thrust unit may be fired separately. The arrangement provides a controlled variable thrust range between the idling output of the variable unit up to its maximum thrust.

Alternatively, the fixed thrust motor can be operated at its maximum rating, combined with any setting of the variable thrust engine.

Combination of two developed units in this way has led to an acceptable powerplant with long life in a much shorter time than would have been involved in designing a comparable engine from scratch, de Havilland said.

Upper and lower motors are virtually independent units carried from a common tubular frame and arranged vertically to eliminate the yawing moment when operated with a differential thrust.

Alignment of the two units ensures that the thrust lines intersect at the center of gravity of the installation concerned.

Only dependency between the two units is the need to start the variable unit first, as this unit energizes the pump turbine of the upper engine until the latter reaches its self-sustaining speed.

Both rocket engines have hydrogen peroxide as the oxidant with kerosene as fuel.

Space Delay Is Blamed on Pentagon

By Russell Hawkes

Palo Alto, Calif.—Any integrated U.S. space program can begin only after 1960 because of the lack of any integrated planning up to the present date, visitors to the Western Regional Meeting of the American Astronautical Society here were told by Frank M. Perkins of Convair Astronautics. American efforts in space have been emergency-paced reactions to Russian accomplishments in the field, he said.

Perkins made his statements at a guest lecture which opened two days of technical sessions and brought forth somewhat more specific information than most recent technical meetings.

Lack of Familiarity

Perkins said U.S. space projects have been and perhaps may continue to be crippled by the "low degree of familiarity" of Pentagon leaders with the subject of space flight. He called for transfer of decision-making authority from these administrative and political heads to the working level where the problems and possibilities of space flight are best understood.

Past decisions on which programs to support and which to abandon have not always been made on the basis of a good technical understanding of which were likely to be fruitful, he said.

Perkins advocated separate development of civilian space research hardware and said that with good administration, unmanned space vehicles with electric propulsion could be launched within three years and manned vehicles with such advanced powerplants could be in operation in from eight to 10 years. Solution to many of the problems of electric propulsion may be the creation of new metals with high albedo light reflection to obtain good high temperature capability by reflecting a large percentage of radiated heat. This would produce a major weight saving. New metal could be something not found in nature but created by transmutation of elements with an electron accelerator.

Lt. Col. David Simons of USAF's Aero Medical Field Laboratory, Holloman AFB, N. M., reported to a press conference that Man High III, next phase of the laboratory's series of extreme altitude balloon explorations, is scheduled for the middle of September. The flight was postponed when Capt. Schock, intended pilot of Man High III was injured in a training flight. He is recuperating well enough to be ready by the mid-September date. Simons said that Russian scientists provided very detailed and specific biological data on the dog in the world's only successful bio-satellite up to that time.

He speculated from this that the Russians themselves may not have drawn much information from the experiment.

Weight penalty in space vehicles for unnecessary structural safety is so high that it may prove more economical to develop ground testing to a far more precise simulation of actual environment than has been done with airplanes, American Astronautical Society members were told by T. C. Helvey of Radiation, Inc. He said the aircraft industry practice of approximating operational loads in ground tests and beefing up the structure by application of safety factors was acceptable because additional fuel needed to carry the overweight was not prohibitive economically.

This will not be true in space flight, he said. Safety factors are needed where it has not been proven that structure and system components will withstand operational stresses. If ground simulation of the space environment is made a more exact science, the payoff will be reduced weight and improved safety, he contended.

Helvey said that within 10 years, miniaturization and reliability of avionics will reach such a degree that most of the equipment can become dynamically and statically a structural part of the space frame.

Space Metallurgy

More study of the field of space metallurgy was recommended. At extremely low temperatures free radicals are metastable and undergo homo or hetero reactions if disturbed, delegates were told. It is likely that interstellar dust contains ice or gas or gas mixtures which are combined into compounds with the free radicals by nuclear radiation. If these free radicals hit the space vessel there can be a violent reaction, most of which is exothermic. The heat or the compound formed of the space dust and hull materials could cause severe erosion. Also antenna metals may change their characteristics at the temperatures encountered in space. If so, it would be wise to study the subject in simulated space environments.

A team of scientists from Lockheed Missile Systems Division described an instrument they have developed which can measure atmospheric density, and temperature and pitch and yaw angles of vehicles at satellite altitudes. Described as simple and rugged, the sensor consists of a highly sensitive microphone separated from an orifice in the forward surface of the vehicle by a mechanical chopper which divides the entering ambient substances into pulses which are registered by the microphone as an alternating current whose amplitude is proportional to impact pressure or atmospheric density. Satellite speed is independently known. Narrow bandwidth and low noise are obtained by passing the microphone signal to a phase sensitive detector using a signal from the chopper as reference. Circuitry is transistorized.

A beam of ambient gas particles spreads as it passes through the orifice because of the transverse thermal velocity components of the molecules. For a given distance between microphone and orifice, spreading will be proportional to the square root of absolute temperature of the gas.

By moving the microphone transversally to map the spreading of the beam, the kinetic temperature of the atmosphere can be measured if the molecular weight of the gas is known. Direction of the beam is determined by the direction of the vehicle's motion. Proper combination of apertures and detectors can measure the orientation of the vehicle relative to this direction for an indication of pitch and yaw.

The instrument can measure variation of density continuously with variation of altitude, latitude and local time.

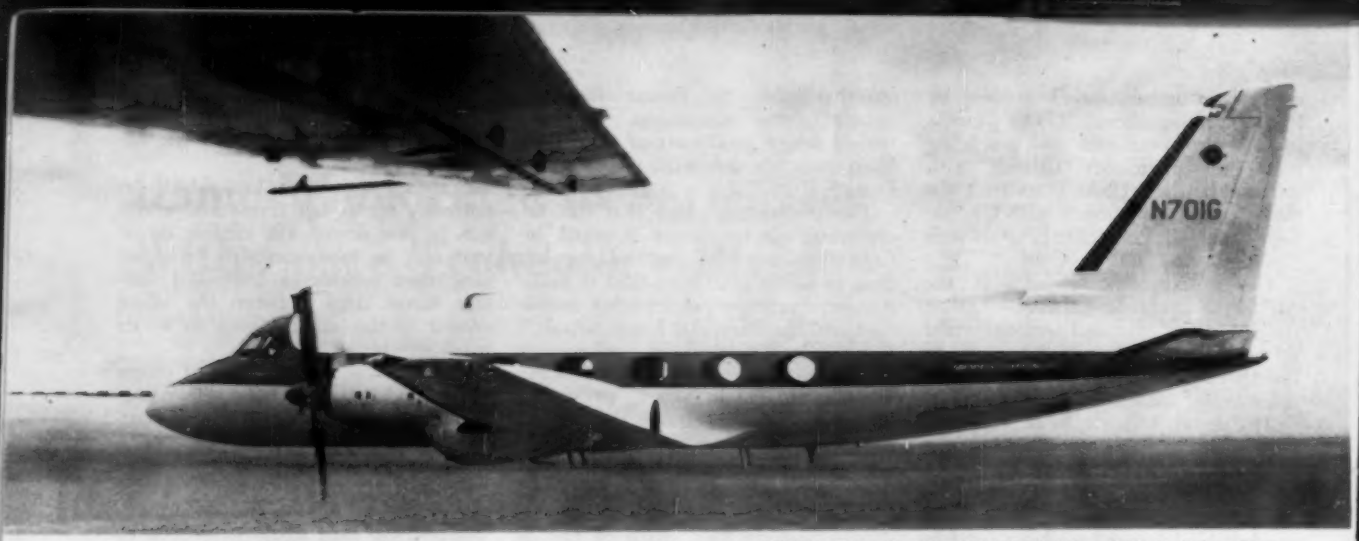
Tracking of satellites yields only average values for the atmospheric density.

Need for more detailed data is shown by rocket measurements at 125 mi. altitude which show variation in density by factors greater than 10 for different places and times.

Tests indicate that the instrument should function at altitudes of at least 300 mi. with signal-to-noise ratios of 12 or more.

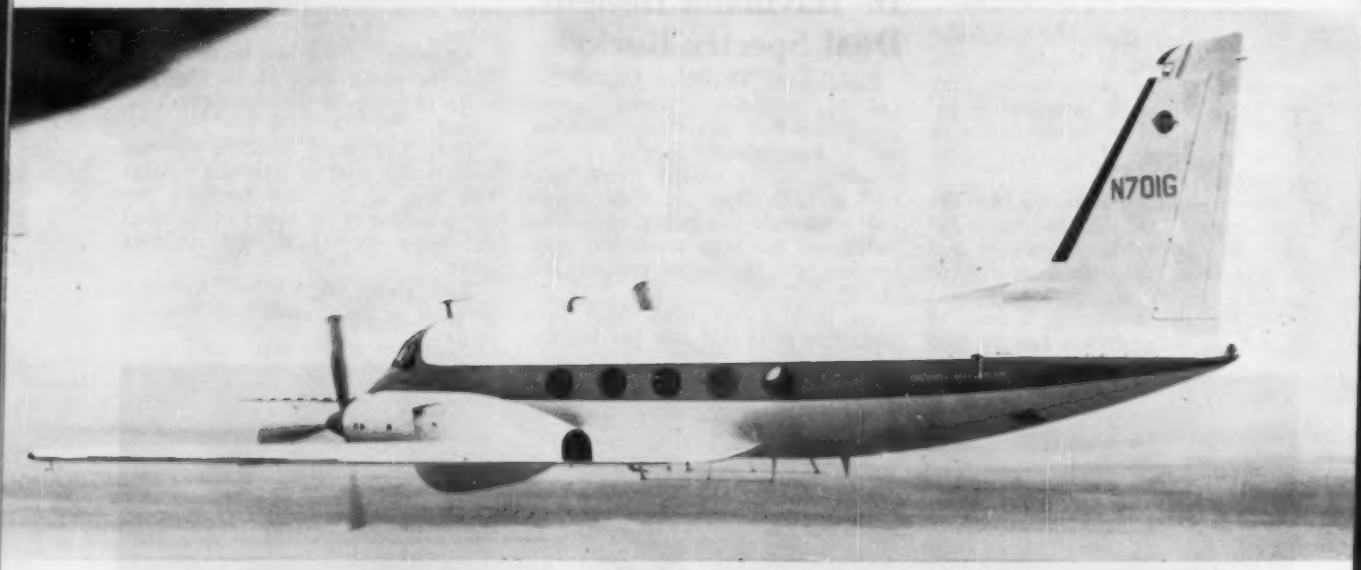
Lunar Frequencies

Optimization studies at Missile Systems Division by Emanuel A. Blasi indicate the best frequency for earth-to-moon vehicle communications is about 250 mc., while the most desirable frequency for vehicle-to-earth transmission would be about 300 mc. Difference stems from differing weight considerations, power availability and practicable antenna sizes. However, Blasi said availability of equipment and frequen-



Grumman's new Gulfstream turboprop executive transport has wing span of 78 ft. 6 in., length of 64 ft., height of 22 ft. 9 in. Outer wing panels are built up of integrally stiffened planks formed from sheet slabs to provide maximum stiffness and fail-safety.

First Flight Photos of Grumman Gulfstream



Gulfstream is powered by two Rolls-Royce Dart R.Da. 7/2 engines with takeoff rating of 2,105 eshp. each. Propellers are four-blade Rotols. Airplane will carry 10 to 19 passengers at maximum cruise of 370 mph. at 25,000 ft. Ceiling is 36,000 ft. Scoops on either side of dorsal fin feed auxiliary power unit, boom on nose is for mounting flight test instrumentation only. Visible antennas on prototype include VOR navigation receiver and VHF communications atop fuselage just behind cockpit; under the belly (bottom photo) are VHF communications antenna used in test program, ADF sensing antennas and a telemetering stub antenna used in flight tests.

Airline Profits May Drop to '49 Low

Net profits of trunkline industry for first six months of this year fall 76% below 1957 level.

By L. L. Doty

Washington—A decided slow-down in the historic growth pattern of the domestic trunkline industry during the first half of 1958 threatens to force net earnings for the year to their lowest level since 1949.

During the first six months of 1958, net profits of the trunkline industry, including gains from the sale of equipment, plummeted approximately 76% from the level reached in the same period last year. With passenger traffic headed for an apparent plateau plus a continuing increase in available seat miles, prospects for an improved profit picture during the balance of the year are poor.

Seriousness of Plight

Seriousness of the current industry plight is best reflected by the falling load factor of the 12 domestic trunklines. Load factor for the year ending July dropped to an eight-year low of 59.30%, a 3.40% decline below the same period of last year.

Vital relationship of load factors to operating profits has been underscored by the Air Transport Assn. In an exhibit filed with the Civil Aeronautics Board in the General Passenger Fare Investigation.

In this case, the ATA emphasized that substantial declines in operating profits will result from a drop of even one point in the load factor. For example, the group pointed out that a one point drop in 1956's load factor would have cut $17.8 million off the industry's $101 million operating profit that year.

Many industry leaders hold out little hope of restoring the current load factor to a healthier level during the balance of the year. Available seat miles continue to rise, although the rate of climb has been eased substantially so far this year.

Nevertheless, the increase remains unchecked—up 8.2% in July, 9.7% in June. With the new turbine equipment ready to come off the production lines coupled with the growing problem of disposing of old equipment there appears to be little chance of arresting the upward trend.

Meanwhile, revenue passenger miles for the 12 months ending in July fell to 24.59 billion, the lowest level hit this year and a .8% dip below last year's figure.

There also is a dangerous slack in traffic volume being handled by the 12 trunklines. During the first six months of 1958, these carriers moved a total of 19,891,000 passengers as compared with 19,750,000 for the same period of last year, an increase of only 141,000 passengers—insignificant in view of past industry performance.

At this feeble rate, total number of passengers carried for the year will fall to show the spectacular annual increases recorded since World War II and may even fall short of last year's record. The industry carried 40.3 million passengers in 1957 against 37.6 million the previous year and 34.5 million in 1955.

Why the Squeeze

Most industry spokesmen were quick to attribute the dwindling traffic picture to the 1958 recession and the two mid-air collisions this year. The profit squeeze was laid directly to an uncontrollable rising cost level which, they said, was rapidly outstripping improved operating revenues.

Expenses continued their steady climb during the first six months of the year with only Eastern Air Lines reporting any success in holding costs below those of last year. With the exception of Western Air Lines, which suffered a three month pilot strike during the first half of the year, operating revenues showed substantial increases.

In most cases, the revenue jump was attributed to the recent passenger fare increase granted the airlines by the CAB on Feb. 10.

Airport Aid

Washington—Congress last week approved legislation increasing federal aid for airport construction from $63 million to $100 million a year. It would extend authorization for the program by five years—to 1963. The House eliminated a provision for a $75 million "emergency fund" to catch up on the backlog of airport projects voted by the Senate, and the Senate went along with the House action.

For example, Eastern reported a 3.8% decline in revenue passenger miles in the six-month period and a .4% decline in the number of passengers carried but showed a 1.2% increase in total operating revenues. The airline's president, Thomas F. Armstrong, pointed out that the six months earnings of Eastern reflected a $2,661,000 gain after taxes from the 4% plus $1 per ticket fare raise.

Generally, the industry continued to call for additional hikes in the fare base as a means of rescuing profits from the economic pinch. However, more than a few airline officials were now privately wondering, in the light of the past six months activities, whether traffic would bear further fare boosts.

Coach vs. First Class

Traffic expansion, during the first six months of the year, was confined almost entirely to coach traffic with first-class traffic showing a consistent decline over the same period. The trend indicates, to some degree, that passengers are now seeking, in growing numbers, bargain prices rather than luxury services.

As a result, evidence culled from traffic trends during the past six months seems to indicate that, whereas revenues may inevitably increase from a fare increase, it does not necessarily follow that the normal 10% annual increase in passenger volume will be sustained if fares are raised.

An unusual case in point is the experience of Northeast Airlines thus far this year. The airline's tourist class traffic jumped from $675,000 during the first six months of 1957 to $6.8 million for the same period of this year. First-class traffic dropped from $4.1 million in the 1957 period to $3.7 million in the first six months of this year.

The trend has been even more evident on North Atlantic routes. International Air Transport Assn. last week reported that since economy flights were introduced on the North Atlantic in April of this year the new low-fare service has accounted for 59.6% of all revenue passengers carried during April, May and June with 19.4% traveling tourist and only 21% flying first-class.

However, most industry leaders argue that, if a higher fare is found to be the cause of a traffic slump, it will be an easy enough matter to adjust fares downward in order to stave off any deterioration of traffic potential. They

cies and desire for spectacular rather than scientific results will probably dominate early decisions rather than technical considerations.

Quarter-million mile ranges and necessity of avoiding effect of ionospheres make frequencies between 100 mc. and 2,000 mc. desirable. Frequencies below 30 mc. are subject to a high level of man-made interferences as well as being strongly affected by the ionosphere. For frequencies higher than 2,000 mc., antennas become gain-limited rather than area-limited and transmission through the atmosphere is heavily attenuated by water vapor, particularly beyond 20,000 mc.

Noise at the receiver can be minimized to cut power demands of the transmitter by simple cooling of the receiver input circuitry and by reducing bandwidth. Value of Maser techniques is limited by the fact that the sky ambient temperature for frequencies below 1,000 mc. exceeds Maser's noise reduction capabilities.

Receiver input noise reduction by cutting bandwith is limited by the desired rate of information flow. In some early lunar probes, it may be reasonable to compromise bit rate for the sake of low noise levels. One to 10 cycles per second would probably be adequate. Teletype requires 100 cps., voice transmission requires 3,000 cps. and picture transmission requires three megacycles.

In the space vessel, conversion of energy available as sunlight, chemical storage and radioactivity into usable power is a critical problem. Key factor is the ratio of power to weight of the possible systems.

Weight factors for different sources listed by Blasi are:

- **Solar batteries**—1 watt per pound.
- **Chemical batteries**—40 watt-hours per pound.
- **Atomic batteries**—700 watt-hours per pound.
- **Energy cells**—900 watt-hours per pound.

These are direct current values. Efficiency of conversion to radio frequencies is typically about 10% and may be as high as 30% below 100 mc.

Continuous communication with space vessels or lunar landing parties can be made possible only by establishment on earth of between four to eight stations at approximately equidistant points in equatorial latitudes.

Attenuations of microwave transmissions by rocket exhaust gases is no more than a few decibels if antenna is located in the nose but may be 100 times greater if the antenna is located near the nozzle exit, according to R. J. Schmelzer of Lockheed Missile Systems Division.

Describing the mechanism of flame attenuation, he said most RF signal absorption is due to free electron-water molecule collisions. Passage of an electromagnetic wave from the antenna accelerates electrons to a velocity several hundred times greater than that of the heavier molecules in the combustion gases, of which one of the most common is water. This effect increases collision frequency and part of the energy received by the electrons from the wave is imparted to the molecules as heat.

Molecular water has the largest collision cross section of any of the substances in the flame. It also is lighter than most of the other combustion products and diffuses more rapidly from the exhaust axis to cast a wider blanket between transmitter and receiver. The electromagnetic wave suffers some change of phase and reflection as well as absorption during its passage through the flame.

Curtiss Ends Studebaker Alliance

New York—Curtiss-Wright Corp. last week terminated its connection with Studebaker-Packard Corp., dropping an option to buy five million Studebaker-Packard shares and ending its management agreement orginally scheduled to run another year.

The increasingly diversified Curtiss-Wright Corp. will buy, for another $2 million, the two plants at South Bend, Ind., and Utica, Mich. it leased from Studebaker-Packard for $25 million and will get full ownership of an American subsidiary of the German automotive and engine company of Daimler-Benz. This will give Curtiss-Wright the right to manufacture the German firm's diesel engines and other products.

When the Studebaker-Packard agreement was made, Curtiss-Wright acquired Aerophysics Development Corp., which makes the Dart anti-tank missile for the Army (AW Aug. 13, 1956, p. 26).

Further Curtiss-Wright diversification is planned, President Roy T. Hurley told stockholders last week in reporting declines in sales and earnings for the first half. Net income of $10,861,462 on sales of $206 million this year compared with $20,712,890 on sales of $313 million last year. Per share earnings dropped from $2.63 to $1.34.

Other financial reports:

- **Kaman Aircraft Corp.** reported sales and earnings gains. First half sales this year were $9,416,473 and earnings $207,147 compared with $7,139,800 and $144,520 last year. Increased sales and a better earnings rate were forecast for the second half.
- **Marquardt Aircraft Co.** sales for a 28-week period ending July 19 totaled $23,359,000 compared with $19,863,000 last year. Net earnings of the company rose from $416,000 to $470,000.

News Digest

Pratt & Whitney J58 Mach 3 plus turbojet for the Navy has successfully completed a 50-hr. running test performed by the company. Only six months have passed since the first experimental J58 was completed. The test and development program for the single spool, 30,000 lb. thrust class engine is being conducted at the new Pratt & Whitney Research and Development Center at West Palm Beach, Fla.

Fairey Gannet Mk. III flew for the first time last week. New version of the turboprop ASW aircraft retains only outer wing panels and tail of Gannet design. Powerplant is believed to be an Armstrong Siddeley Double Mamba ASM.8.

Handley Page obtained private backing of a medium size jet transport utilizing boundary layer control and designated the HP.113. Two Bristol Orpheus turbojets tail mounted will be the powerplants.

Engineers Plan Strike

New York—Eastern Air Lines flight engineers last week definitely planned to strike following a decision by the airline that it would accept a fact-finding board's recommendation for pilot-qualified engineers.

The Presidential emergency board's report was issued July 21 (AW July 28, p. 32), and the 30-day period for parties to consider it expired at midnight last Wednesday. The union now is free to strike.

Negotiations over the long-delayed contract between Eastern and Flight Engineers' International Assn. continued until late last Wednesday and had been bogged down in wage questions even before the airline's announcement. Some 660 engineers in the Eastern chapter of FEIA are involved.

The 750 FEIA members in Pan American World Airways' employ last week also voted to give the unions the authority to strike if the airline ever negotiates with Air Line Pilots Assn. on the third-man issue. Similar votes among all other airlines with FEIA contracts are likely soon, the engineers said.

Center, McCarran tower at Las Vegas and Nellis AFB personnel.

United Air Lines officials testified that the carrier had no knowledge at that time of the CAA-Air Force agreement and thought it unreasonable that it should have expected that jets were being flown uncontrolled in the center of a highly traveled airway..

The airline said it later lodged several near-miss complaints from the area with the CAA but never obtained any action.

Emphasizing that the Civil Aeronautics Administration, by its own testimony, was aware of the extent and nature of the Nellis training program and the difficulty of maintaining visual separation between military and commercial aircraft in the area, the Board said that the agency "exercised poor judgment in failing to take any action" with respect to the hazardous conditions, even though it was "reasonable to expect" that it should have done so.

Pointing out the CAA's defined duty to regulate air commerce in a manner to encourage its development and safety, the Board said, "We do not feel this was done in this case," explaining that CAA made no attempt to reach a voluntary solution to the hazardous conditions with the military after United filed several complaints. Such action was not done until after the accident when a joint CAA-military survey team was formed to review military activities throughout the country and to re-examine the jet penetration procedures at Nellis AFB, the Board members pointed out.

CAB Statement

Stating that many of the actions initiated by the CAA and Nellis following the accident could "reasonably have been taken before it occurred," the CAB said that United's complaints, which resulted in conferences "but no other corrective measures" showed a need for and should have furnished the impetus for some of the later steps. While United knew of the jet penetrations, the Board said it did not believe the airline should have suspected that the KRAM penetration procedure would be used regularly and frequently as a VFR training maneuver.

Citing the size of the staff of safety technicians employed by the CAA and the working knowledge of aviation safety enjoyed by the administrator, James Pyle, the report also scored the failure of Pyle to report the hazardous conditions that existed in the Las Vegas area. The Board explained that, where the administrator is aware of such a condition, but is powerless to act, he is required to bring the matter to the attention of the CAB under Section 301 of the Civil Aeronautics Act.

House Unit Criticizes CAA Procedures

Washington—Civil Aeronautics Administration came under congressional fire last week following completion of a study of the agency's functions.

In a report of its findings, a House Government Operations Subcommittee headed by Rep. John A. Blatnik (D.-Minn.), urged the CAA to immediately adopt these recommendations:

• **Accelerate a current study to** segregate military jets and civil aircraft. The committee said CAA's current study of traffic volumes and flight patterns of military aircraft should "be given highest priority" since two recent crashes involved collisions between military jet aircraft and civil airliners. CAA also was criticized last week by the Civil Aeronautics Board for failing to act on "near miss" reports. Criticism was contained in a Board report on its investigation of the April 21 collision between a United Air Lines DC-7 and an Air Force F-100F over Las Vegas (see page 30).

• **Consider revising present** cockpit visibility standards. In light of the CAA belief that "see and be seen" theory will continue for an undetermined time as part of the air traffic control system, the subcommittee said. Study of its efforts requires "concentrated effort . . . without delay" as a "matter of prime importance." Members also said findings of limited cockpit visibility by the Air Force Accident Investigation Board in the Brunswick, Md., collision and experiments with luminous paint point up the importance of cockpit visibility.

• **Immediately begin a re-evaluation** of restricted areas of air space. Department of Defense air space claims have hampered efforts to plan domestic jet routes, the report said. It added that immediate request by CAA for a justification of restricted air space claims would enable the agency to deal with this problem on an over-all, rather than a "piecemeal," basis.

• **Revise runway length standards** to handle commercial jets. Committee members said they recognized that changes in weight and range for jet aircraft during the past two years made it difficult for the CAA to determine definite runway lengths needed but added that the agency could have made some recommendations earlier than the present draft revision now being circulated.

• **Improved communications** with airport operators to aid in airport planning. Following complaints by airport operators present that their first knowledge of cities to receive the first jet service was gained from CAA testimony at the hearings, the subcommittee characterized this situation a "glaring weakness in CAA operation." Demanding "new vigor" and a "better pipeline" to the airport operators, the congressmen also criticized CAA for not prescribing criteria for airport separation.

• **Prompt action to resolve** administration matters pertaining to air traffic controllers. The subcommittee cited the delay in agreement between the Civil Service Commission and the Civil Aeronautics Administration on job standards for controllers as an example of "poor administration."

CAA testimony that controllers were unable to take regular lunch and rest periods because of the nature of their work and that steps to correct the situation would require additional personnel, in conflict with the agency's "obligation to the taxpayer," also was discredited by the subcommittee.

Its report observed that "as a matter of operating efficiency, it would seem obvious that the failure of such personnel to participate in what every other calling takes for granted, and the resultant effect on their mental and physical health, could impair the efficiency of the air traffic control system."

PanAm's 707 Begins N.Y.-San Juan Trials

New York—Pan American World Airways' newly-certificated Boeing 707-120 was scheduled to arrive at Idlewild last Saturday and to begin trial New York-Puerto Rico service today. Civil Aeronautics Administration on Aug. 15 granted the 707-120 series a provisional type certificate allowing the jet transports to be operated on training, route proving and other non-revenue flights. Full type certificate is expected soon after data from the completed flight test program has been processed.

Pan American hopes to inaugurate transatlantic service in November. Meanwhile, British Overseas Airways Corp. Chairman Basil Smallpeice announced last week in London that BOAC will begin Comet 4 service on the North Atlantic in early December. The de Havilland jet will be operated once-weekly in deluxe service at the start, stepped up to daily runs shortly thereafter, Smallpeice said. In May, 1959, the airplane will go into London-Hong Kong-Tokyo service on a four times weekly basis.

Pan American took delivery of its first 707-120, actually the third production airplane, at Seattle on the date of its provisional certification. A second aircraft is scheduled for Sept. 19 delivery and a third on Oct. 25.

The first airplane was expected to fly from Seattle to Miami last week and then proceed to San Juan. It was to leave San Juan Aug. 23 and arrive at New York the same day.

claim that airlines will take such action voluntarily and add that this is the only logical method of working fares into their most productive areas.

The entire industry will be forced to act quickly if traffic trends level off since all future plans are based on a continuance of the traditional growth pattern. Falling load factors, excessive seat miles and low utilization will result from a traffic decline and will nullify any economies stemming from the introduction of larger and faster jet aircraft.

Forecasting of traffic is adventuresome at best and most airlines lean far to the conservative side in making predictions on which to base equipment plans.

Nevertheless, most forecasts vary widely. In a recent study, the International Civil Aviation Organization said that, during the past five years, forecasts made by "five competent bodies" on U.S. domestic service produced the following five results for the year 1965: 16.7 (billions of passenger miles), 24.8, 37, 43, and 52.8.

The same report forecast a 15% annual traffic increase from 1958 to 1961 but warned: "Even assuming that there will be no serious economic recession this growth rate cannot be expected to continue indefinitely, and it will probably begin to fall off when it is no longer possible to introduce traffic attractions such as cheaper tourist and economy fares, improved speeds and comfort, new routes or services or more convenient schedules."

In the report, the group had this to say on the productivity of jet fleet: ". . . One of the long-range turbojets is approximately equivalent to three of the latest piston-engined types or to 20 DC-3s."

This new problem of excess capacity versus a limited traffic potential was raised in the recent report prepared by Dr. Paul W. Cherington for Presidential Aide Elwood Quesada. On this point, here is what Cherington has to say, and many students consider this the crux of the report;

"On balance, it must be concluded that, while the equipment program cannot be described as unreasonable, there is at least room for doubt that the necessary traffic can be generated to make enlarged capacity economically sound. Greater credibility could be given to the carriers' traffic forecasts if they could identify the new classes or types of customers who they believe will provide the almost doubled volume of traffic.

"It seems certain that such traffic increases will be forthcoming only with extensive efforts by the carriers in the form of researching new markets and developing programs to serve them. Considerable work and experimentation is called for by the carriers to price their new volume in a realistic manner."

Civil Aeronautics Board Raps CAA in Las Vegas Crash Report

By Robert H. Cook

Washington—Failure of the Civil Aeronautics Administration to act on earlier "near miss" reports in the Las Vegas area was a major cause behind the April 21 mid-air collision between a United Air Lines DC-7 and an Air Force F-100F, the Civil Aeronautics Board ruled last week.

While criticizing military jet penetrations of the heavily traveled airlanes surrounding Las Vegas, the Board was particularly critical of CAA's failure to assure safe separation of military and commercial air traffic operating under the "see and be seen" principle until after the collision which claimed 49 lives and resulted in strong congressional demands for tighter control of air space (AW April 28, p. 40).

At the same time, the CAB gave notice that it does not intend to drop the fundamental principle for VFR flights on grounds that any existing alternatives, such as full positive control, would result in the grounding of a majority of current air operations.

The accident occurred in clear weather conditions while the DC-7 was on an IFR flight plan from Los Angeles to New York and the F-100F from Nellis AFB was executing a jet penetration under a VFR flight plan. At 0811 the airliner reported over Dagett, Calif., at 21,000 ft. and estimated Las Vegas at 0831 . . . the exact time a "Mayday" call was received from the aircraft reporting a collision.

At 0828, the F-100F reported to the Nellis tower that it was over KRAM, a local commercial broadcasting station, at 28,000 ft. and requested and received clearance for a simulated instrument jet penetration of Victor Eight Airway on which the DC-7 was traveling. Three minutes later, Nellis heard a "Mayday" call from the jet aircraft plus a message of either "flame out" or "bail out."

Report of Witnesses

Witnesses to the accident said the two planes met nearly head on with the jet attempting a roll over out of a collision course at the last second. Both crewmembers of the F-100F were killed as well as the 42 passengers and five crew members that were aboard the DC-7.

Crux of the Civil Aeronautic Board's findings that the CAA was largely responsible for the accident stemmed from approval by CAA on May 10, 1957, of four jet penetration procedures adopted by the Air Force training base at Nellis. The KRAM penetration being used at the time of the accident, was almost entirely within the limits of Victor Eight Airway, the Board said. Along with three other penetration plans used by the military in that area, a total of 40-60 jet penetrations were being made daily, according to Air Force witnesses. CAA spokesmen said they were aware that the KRAM procedure was to be used extensively in VFR conditions for practice purposes, requiring use of the "see and be seen" principle. Therefore, they said, copies of the CAA-Nellis agreement were distributed only to the Salt Lake Control

Pyle Rebuttal

Washington—Civil Aeronautics Administrator James T. Pyle last week said the Civil Aeronautics Board authorized the type of flight procedure which resulted in the Las Vegas mid-air collision between a United Air Lines airliner and a military jet.

Replying to CAB charges placing most of the blame for the accident on failure of the CAA to act on earlier near-miss reports in the area (see story above), Pyle said the Board had failed to grant CAA effective regulatory power to compel any different kind of operation than the CAB had authorized, thus leaving any change dependent upon a voluntary agreement between air space users.

Answering Board criticism that corrective measures taken since the accident should have been accomplished earlier, Pyle said that air space users were not willing to make the voluntary concessions necessary to achieve corrective action until after both the Las Vegas accident and a later mid-air collision at Brunswick, Md., between a Capital Airlines Viscount and an Air National Guard T-33.

Inability of the CAA to act effectively in the Las Vegas area, he said, stemmed from the "same basic conflict between users which induced the Board not to take regulatory action which might have contributed to prevent these accidents." Pyle added that creation of the Federal Aviation Agency would eliminate the need to rely on voluntary agreements between air space users to minimize collision hazards.

Phillips Electronics Co. Subsidiaries include the following banks and insurance companies:

Bank of Georgia (Atlanta), 96% ownership; Buffalo Industrial Bank, 80%; Industrial Bank of Commerce (New York City), 64%; Union Trust Co. of D. C., 67%; Industrial Insurance Co., 99.77%; Northeastern Insurance Co. (Hartford), 61%; Bankers Security Life Insurance Society, 18%.

Intermediate's lease proposals for new aircraft will offer three means of buying the equipment if the carrier so desires. If for tax purposes the airline doesn't want to capitalize the equipment, it can lease for the payout term, then re-lease at a nominal figure, perhaps ⅛ of the former cost. Intermediate will be willing to sell the equipment at that time at a certain residual value and the carrier can buy it.

Other purchase arrangements are a straight firm option to buy, and a straight lease-purchase contract under which payments would go toward the purchase price.

The Cherington Report listed the amounts individual carriers required for their jet financing but had not arranged as of April, 1958, as follows:

Carrier	Financing Required But Not Arranged (Millions)
TWA	$313.3
Pan American	115.3
Northwest	63.5
Capital	53.5
National	47.5
American	31.9
Delta	28.8
Northeast	26.3
Eastern	22.6
Panagra	18.0
Continental	17.8
Western	17.2
United	8.0
Braniff	
Total	$763.7

As noted above, American Airlines eliminated its need for new financing, at least at present, by consummating its engine lease arrangements. Continental Air Lines raised about $12 million in June through sale of debentures.

Fog Linked to Crash Of Northeast Convair

New York—Northeast Airlines Convair 240 which crashed Aug. 15 on approach to Nantucket, Mass., killing 22 persons and injuring 12, encountered fog and hit about 300 yd. from the airport. One of the injured passengers later died.

Northeast's minimums for approach are 400 ft. ceiling and 1 mi. visibility. For every additional 100 ft. of ceiling, visibility can be reduced ¼ mi., down to a minimum of ½ mi. Since there was no ceiling on the night of the accident, the legal minimum visibility was ½ mi.

The approach at Nantucket is via VOR. Terrain from the northeast is flat, and the initial approach would be over water. Between water and the airport, the last 5 mi. is land. Approach was made to Runway 24. VOR station is 1.9 naut. mi. from the end of the runway. Also, between VOR station and runway, about 7/10 stat. mi. northeast, is an "H" facility—radio beacon.

Weather reported about 5 min. before landing was "visibility ½ mi."

27 Vortac Stations Currently Installed

Washington—Total of 27 Vortac stations are now installed, 258 are expected to be installed a year from now as originally scheduled, with a total of 346 installed by June 30, 1960, Civil Aeronautics Administrator James T. Pyle has reported to the Legal and Monetary Subcommittee of the House Government Operations Committee.

Pyle says CAA "anticipates no serious difficulty with respect to reliability of Vortac equipment, although there are too few completed installations to permit statistical analysis on this matter."

The CAA administrator conceded that there had been some difficulties with initial installations which use early design military equipments but added that this is characteristic of any new equipment. Pyle said CAA is now installing Tacan equipments of more recent vintage which incorporates a number of improvements intended to boost reliability.

Only witness to criticize progress of Vortac implementation was Max Karant, vice president of the Aircraft Owners & Pilots Assn. and a long-time foe of Tacan who bitterly opposed the Vortac compromise of two years ago.

From the reliability standpoint, Karant charged that Vortac is "flatly unacceptable to any segment of civil aviation in its present form." This claim received no support from prepared testimony of spokesmen for Air Transport Assn. and National Business Aircraft Assn. who appeared before the subcommittee.

A CAA spokesman later told Aviation Week that one Vortac is commissioned at Phillipsburg, Pa., and that the remainder will be commissioned shortly as monitoring equipment is delivered by the manufacturer.

Karant also charged that existing VORS must be shut down for one to three months in order to convert them to Vortacs. The CAA spokesman contended, however, that shut-down of VOR now runs no more than 30 days and in some instances as little as two weeks.

ATA's Milton Arnold commended CAA for "its demonstrated ability to make transition from a low-level establishment program to one 20-fold greater, with efficiency and effectiveness." Arnold acknowledged the improvements expected to result from use of long-range enroute radar and increased VOR facilities.

He said, however, that the radar beacon (transponder) system, badly needed particularly for control of jet aircraft and amplification of radar signal returns under bad weather conditions, "is not progressing satisfactorily."

Airline Officers Named To Aid AMB Program

Washington—E. R. Quesada, Chairman of the Airways Modernization Board, has named seven airline officials to comprise an airline advisory group organized to assist in the Board's research and development program.

The group will act in a consulting capacity to the AMB's various technical groups and will actively participate in the Board's aviation facilities modernization projects. The seven members of the advisory group are:

C. M. Christenson, United Air Lines; M. V. Cochran, United Air Lines; J. H. Gibson, American Airlines; W. W. Lynch, Pan American World Airways; F. C. Nicholson, Piedmont Airlines; W. M. Ragland, American Airlines and K. J. Rhead, United Air Lines.

CAB Office Files Northeast Complaint

Washington—Civil Aeronautics Board has been asked by its compliance attorneys to issue a cease and desist order against Northeast Airline's "so-called commuter service."

In a complaint filed by CAB's Office of Compliance, the airline is charged with discrimination against other passengers by offering advance reservations and confirmed seat space to users of the special service.

The compliance attorneys charge the practice constitutes an "undue preference," pointing out that commuter service reservations were often made as much as eight months in advance and resulted in noncommuters being unable to get seats. The complaint further stated that the advance reservations were held until seven days prior to departure and were then placed on a "wait list" if not confirmed. In addition, the Office of Compliance criticized selection of passengers eligible for commuter service by a special "executive desk" operated by the airline.

Leasing Studied as Jet Finance Solution

By Glenn Garrison

New York—As much as $100 million in capital may be channeled into equipment leasing plans in the next few years by an investment company that is offering the airlines one possible way out of their jet financing problems.

Convinced that large-scale lease or lease-purchase arrangements may in many cases provide the best answer to the jet-age money pinch, Intermediate Credit Corp., a subsidiary of Financial General Corp., is discussing several plans with the industry.

Magnitude of the carriers' need for capital to meet their equipment commitments was pointed up in the recent Cherington Report to Presidential Assistant Elwood Quesada (AW Aug. 11, p. 28). According to the report, $760 million in financing was required but not yet arranged as of April, 1958.

Difficulty for many carriers of raising capital at normal interest rates and terms, if at all, under present conditions in the industry already had led to some cutbacks and stretchouts in jet orders, the report disclosed. American Airlines recently reduced its need for capital investment by entering into a lease arrangement for three types of turbine engines, setting a U.S. precedent for non-ownership of equipment (AW Aug. 4, p. 38).

Problem Areas

Edward N. Townsend, Jr., recently appointed an Intermediate Credit vice president to handle the new activity, is working in three areas where he believes the main problems facing the industry lie:

- **Purchase of new equipment** for the trunk carriers. This includes aircraft, engines, parts and ground equipment. Carriers would negotiate purchase of their own equipment, with Intermediate providing the money, retaining title, and leasing the equipment to the carrier in a long-term deal. Lease-purchase plans also are contemplated.
- **Local service** and corporate equipment. These operators will be offered a "power by the hour" proposal under which they would pay for the use and overhaul of engines by the flight hour. Aircraft lease also will be available to these groups.
- **Used aircraft disposal.** One plan developed by Intermediate involves purchase by the financial company of an airline's obsolescent aircraft, which are leased back to the carrier until replaced by new equipment.

Intermediate has already established "working arrangements" with various banks and insurance companies to provide capital for the lease programs, according to Townsend. In addition, his own company has interests in a number of banks and insurance firms and can be expected, Townsend said, to participate within its own credit structure to the extent of 10-20% of the total capital of the plan.

The Intermediate official feels that there is a long-term basis for the new activity and that the field has lacked an organization with sufficient management experience and capital to undertake such a program on a large-scale level. Many airlines are "unsophisticated" about the real cost of their capital, he maintains. Such cost for an airline may amount to 12-15%, whereas a large business organization with sophisticated knowledge of capital costs may pay a maximum of 10%.

Leasing Cost

Townsend said the cost to the carrier of straight leasing through Intermediate may run about 7-9% of the capital involved. This is approximately 3% over the cost of the money to Intermediate, he said.

One disadvantage to an airline of leasing rather than buying its equipment is the lower total invested capital figure upon which rate-making decisions may be based.

Intermediate is currently working with two overhaul agencies on the "power by the hour" plan, Townsend said. Under the plan, a local service or corporate operator could buy his aircraft —or lease it from Intermediate—and turn all responsibility for its powerplants over to the company. This could include the installed engines and spares. In conjunction with an overhaul agency, Intermediate would provide the airline with engines and charge by the flight hour.

Price of the power would be based on two factors: payout of the cost of the engines, plus Intermediate's profit on its investment; and overhaul costs plus the overhaul agency's profit.

Intermediate is considering several approaches to the used aircraft disposal problem, a cause of great concern to both the aircraft and airline industries (AW July 7, p. 26). One plan would work as follows:

Airline with piston equipment such as Douglas DC-7s, which it must retire in several years as turbine equipment is delivered, sells its piston planes to Intermediate, then leases them back and keeps them in operation. The aircraft are immediately listed with brokers, and the manufacturers also try to line up buyers before the planes are actually retired.

The carrier, through the sale to Intermediate, has obtained working capital to apply against the price of its new equipment.

Manufacturer's Agreement

Part of Intermediate's investment will be amortized over the term of the lease. To guarantee the rest of the purchase cost, the manufacturer in some cases would agree to buy the planes from Intermediate if they were still unsold at the time of retirement.

A related plan under discussion with the manufacturers, according to Townsend, is to set up a private industry-government pool composed of a joint manufacturers' corporation, Intermediate, and the Federal International Finance Corp. for lease-purchase deals with foreign buyers of used aircraft. If such an arrangement could be worked out, credit extended to the foreign buyer would be backed by the organization with the risk split among its members.

Intermediate is also interested in leasing jet ground equipment to carriers, either for individual use or possibly for pool arrangements. Another area is shop equipment.

Financial General, Intermediate Credit's parent company, is in turn owned by Equity Corp., which among other investments has a controlling interest in Bell Aircraft. Financial General's interests include 37,500 shares of

Fastest But Slowest

Moscow—Russia's famed satirical magazine Krokodil says that Aeroflot not only has the world's fastest airline service but the slowest as well.

According to the Soviet publication, one of its correspondents recently boarded a twin-jet Tu-104 in Moscow and arrived in Omsk—1,600 mi. away—in three hours. But travel time from the Omsk airport to a downtown hotel "via bus, street car and foot" was 3 hr. 45 min.

This, Krokodil continued, was nothing compared to the experiences of agronomist I. A. Titar who, together with other passengers, waited five days in a collective farm stable near the Uspenka airport (there was no better shelter available) for a feeder plane to Pavlodar. "Finally two planes for Pavlodar arrived at the same time, and one of them left half empty."

Krokodil observed sarcastically that the contrast between Aeroflot's service on the ground and in the air is so great that a passenger is reluctant to leave his plane when he arrives at his destination.

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Weight: 12 pounds 6 ounces.
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AIRLINE OBSERVER

► President Eisenhower has been handed a list of eligible candidates for the top post in the Federal Aviation Agency by Presidential Aviation Aide Elwood Quesada. Possibility is strong that Eisenhower will nominate Quesada himself this week as administrator with Civil Aeronautics Administrator James T. Pyle as his deputy. Quesada's chief interest now is to see the agency successfully launched with a competent staff and workable organization. Once this is achieved, he will retire with Pyle moving into the administrator's slot. Another strong candidate for the post is Slick Airways President Delos W. Rentzel, former CAA administrator and Civil Aeronautics Board chairman. A number of politicians, including Commerce Undersecretary Louis Rothschild, are reportedly making a bid for the job. The act creating the agency specifically states that the administrator at the time of his nomination shall have had "experience in a field directly related to aviation."

► Delta Air Lines and the city of Atlanta have entered into an agreement covering the construction of a $10 million jet overhaul base at the Atlanta airport. Under the terms of the agreement, the city will issue $6.5 million in special revenue certificates which Delta will amortize at the rate of $239,000 annually for a period of 25 years.

► Aeroflot, Soviet-owned airline, is publicizing the "superiority" of its service over Sabena's competing operation on the new Moscow-Brussels route. Soviet press is emphasizing that Aeroflot's twin-jet Tu-104s cover the route in 3 hr. 45 min. as compared with 5 hr. 40 min. for Sabena's DC-7s.

► Capital Airlines blue-ribbon service, called V. I. P. for "very important passenger" on a number of its major routes resulted in a 12 point load factor increase during the first week of its operation. The airline's sales officials are now hoping that the project will bring about an 80% or higher load factor on the special service flights. Program underwent a four-week trial run before it was inaugurated with the company's top-level officers, including President David Baker, flying the trips as critical observers during the shakedown period.

► Pan American World Airways has applied to the Civil Aeronautics Board for permission to suspend its West Coast-Paris polar route service Sept. 28 and to reduce West Coast-London polar route service from six flights a week to three. Pan American contends that the route, which Air France is eager to operate (AW Aug. 11, p. 31), will experience a heavy traffic drop in winter and that jet service this winter will divert what traffic is available to transatlantic routes.

► Communist China spokesmen say quantity production of the country's first locally-produced transport aircraft, the Russian-designed An-2, is well ahead of schedule and that the single-engine 10-passenger biplanes will be built this year at a rate 50% higher than originally planned. First Chinese An-2 was manufactured late last year.

► Assn. of Local and Territorial Airlines is rapidly developing into the sole representative of the local service industry and is closing the sharp breach caused within the industry last year by the resignation of six carriers from the Conference of Local Service Airlines (AW April 1, 1957, p. 38). Latest carriers to switch from the all but defunct Conference are Mohawk Airlines and Pacific Air Lines, bringing total membership of the new association up to nine out of 13 local service carriers.

► Civil Aeronautics Administration is conducting tests to determine the feasibility of operating helicopters under instrument flight rules and on airways. Purpose of the tests is to study procedure requirements necessary to mix fixed wing and rotary wing aircraft in normal instrument traffic.

► British Overseas Airways Corp. and Middle East Airlines have reached a pooling agreement that permits the sale of the combined services of the two companies on routes between Britain and Middle East.

SHORTLINES

► **Aer Lingus** reports an operating surplus of $94,400 for the fiscal year 1957-58 ended March 1. During the period, the airline operated 18,901 revenue flights in Europe and carried 441,363 passengers and 8,334 tons of freight and mail. Total revenue was near $8,466,000 with total expenses slightly more than $8,370,000. The figures do not include operations of Aerlinte Eireann (Irish Airlines), which did not begin transatlantic operations until April 30, which was after the closing of the airline's fiscal year.

► **Lockheed Electra turboprop** transport has passed New York Port Authority "noise pressure" tests. Data obtained for Port Authority by Bolt, Beranek and Newman Inc., acoustics consultants, indicates the Electra is quieter 1.47 mi. from start of takeoff than present airliners are at a point 2.2 mi. away.

► **Northwest Airlines flew** 1,006,367,000 domestic revenue passenger miles during the 12 months ending July 31. The new company record is 11% higher than the previous period when the airline flew 903,923,000 domestic passenger miles. Northwest's July passenger miles also increased over last year. The airline flew 109,757,319 domestic passenger miles, a 15.6% increase over July last year, and 31,531,328 domestic passenger miles, a 15.8% increase, for a total July revenue passenger mile figure of 141,288,647.

► **Olympic Airways** of Greece has begun flight on a three weekly basis to Frankfurt, Germany. The airline also plans to extend the route to London.

► **Pan American World Airways** will extend its South Pacific route from Sydney to Melbourne on Sept. 28 to coincide with introduction of Douglas DC-7C aircraft on the Australian service. Melbourne will have four arrivals and departures weekly. The DC-7Cs, replacing Boeing Stratocruisers, can fly nonstop from Fiji to Honolulu, eliminating a fueling stop at Canton Island. This, coupled with the higher speed of the DC-7C, will cut nine hours from Sydney to San Francisco run and six hours from Sydney to London via the polar route, according to Pan American.

► **United Air Lines** reports it broke company records for July by registering 492,140,000 revenue passenger miles, a gain of 1% and 12,583,000 revenue airplane miles, a gain of 5%.

Satellite Controls Pose Major Problems

By Richard L. Sweeney

San Diego—Three problem areas in satellite attitude control were outlined during a recent space exploration meeting here by Robert E. Roberson of North American Aviation's Autonetics Division.

Survey of existing, generally available literature on satellite attitude control indicated several areas ripe for thorough investigation in this field, according to Roberson.

Meeting, sponsored by the Air Research and Development Command, American Rocket Society and Institute of Aeronautical Sciences, had technology sessions, a panel on the sociological impact of space exploration, and a human factors session.

Three Major Areas

Initiating the survey, Roberson outlined three major areas constituting the first principles of the attitude control problem.

The first area he defined as a set of "foundation problems," the second a quantitative description of attidude motions; i.e., formulation of basic equations of motion, and the third the performance requirements.

First of the foundation problems, Roberson said, is whether the entire vehicle is to be controlled or only a certain number of its moving parts. Although the answer will depend largely on mission requirements, some control over the entire vehicle is required and has been treated extensively. The condition of stabilizing several parts has not been treated as yet.

Second foundation problem is an attitude reference system, with several papers mentioned which have dealt with a satellite with one axis to be kept pointed down toward a mother planet, and one discussion of this orientation and the inertially fixed orientation provided by a spin stabilization. Roberson also mentioned a paper on a basic reference system for spacecraft as distinct from satellites, concerned with geometric orientation in the solar system, which could be a frame for a natural attitude reference system.

Completing the foundation problems, Roberson said, is the choice of a set of reference axes in the satellite and definition of suitable deviation angles between vehicle axes and attitude reference axes.

Roberson discussed the literature on control devices for satellites, pointing out the possible interrelationship between physical sources of attitude perturbations which also are potential sources of control torques.

He also discussed sensing devices for attitude control, noting literature on the several systems which can be used for this purpose.

The complete control system, Roberson pointed out, is the heart of attitude control, including the control or actuator device, the attitude or rate sensing device, and the control filter or computer.

Although a number of systems have been mentioned in the literature, Roberson says, not many details have been presented on the synthesis or performance analysis.

Three areas where work is especially desirable, Roberson said, include development of new systems for control in addition to such as flywheels, jets, inherent stability and combinations of these.

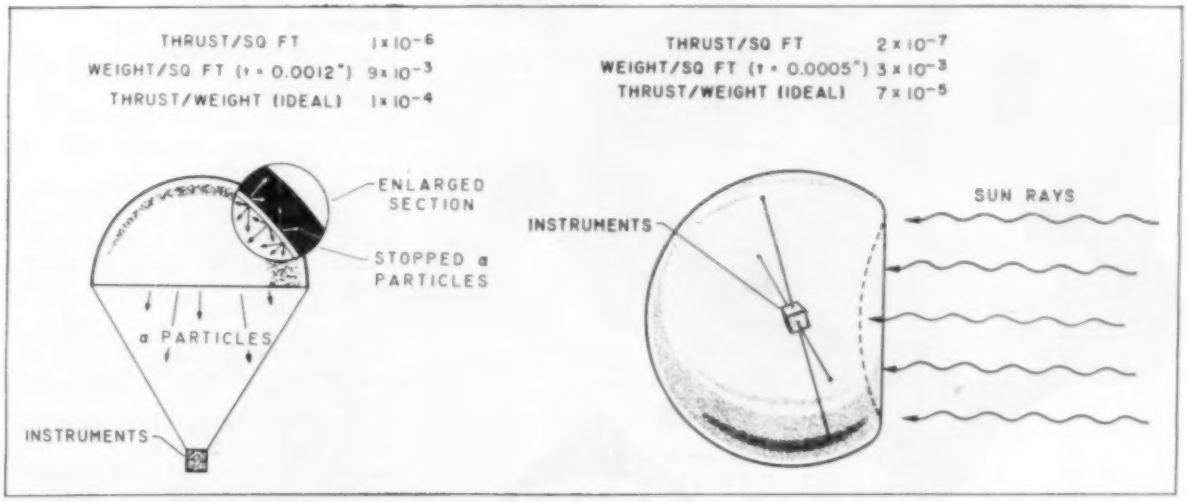
Synthesis Problem

Second area, is to consider more seriously and much more thoroughly the synthesis problem as a problem of servomechanism design.

The third area, is to analyze the resulting system performance with special attention to the effect of instrument errors.

A question not covered, Roberson noted, is man's function in attitude control.

Another question not covered, he added, is the general area of design principles to ease the attitude control problem as much as possible. Quoting



NACA Space Vehicles Would Be Self-Propelled

National Advisory Committee for Aeronautics drawing shows a radio-isotope sail, left, and a photon sail, right—vehicles designed to propel themselves through space. Propulsion methods are feasible but do not appear promising for most space missions. Both vehicles would produce very low thrust per unit area or weight. An extremely large area would be needed to carry a sizable payload.

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In spite of the tremendous retaliatory action our Air Force can take in case of attack, the United States Army bears the burden of stamping out the brush fire wars which might ignite the holocaust of World War III. In this heavy responsibility our GIs are backed by the Tactical Air Command which is ready around the clock to provide the Army with the air support without which modern foot soldiers cannot survive. But fire fighting in Kansas or Korea is a dangerous business and TAC will go all out to give its pilots every protection, including Kaman H-43 local crash rescue helicopters.

PIONEERS IN TURBINE POWERED HELICOPTERS

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acceleration being among the best presently conceived.

In a paper on power sources for ion propulsion engine by A. L. Huebner and R. H. Boden of Rocketdyne Division of North American Aviation, nuclear energy and solar means were assessed for their potential, and an analysis of problem areas conducted.

Acknowledging the limitations of solar power, the paper noted that concentration was on a nuclear generation system. In this, two systems for mechanical conversion of the nuclear reactor's heat to energy were studied—a Brayton cycle using helium gas, and a Rankine cycle using mercury and alkali metals, with alkali metals showing up better than mercury.

Use of the Rankine cycle permits lower turbine inlet temperatures and requires less pressure, less radiation area to dissipate heat built up in the cycle.

Consideration had a sodium-cooled reactor and heat exchanger functioning to effect transfer of thermal energy from the reactor to the power conversion cycle. Possibilities of cooling the reactor with the working fluid also were studied, but properties which make a good working fluid are not actually always the desirable ones for coolant and vice versa.

Authors noted that good hardware is needed for the conversion, among the items being a permanent magnet rotor or group of rotors capable of working for extended periods in space and radiation environments.

Possibility was discussed of using an electrostatic generator of the type producing voltage from a change of capacitance of a variable condenser, since this operates in a vacuum, has a high efficiency and generates a high voltage.

Paper noted that the generator must be cooled, like other parts of a spacecraft, and might have a closed cycle air blast or refrigeration system.

Materials Studies

Fine filaments of materials, commonly called "whiskers," have demonstrated the highest strengths known, in some instances approaching the theoretical limit of atomic cohesion, according to a paper by George A. Hoffman of Rand Corp.

His paper investigated possibilities of putting this strength to work in structures, and with structural characteristics of hypothetical materials composed from whiskers, a comparison with weights of tension structures from conventional materials was made. Weight reductions to one-fifth present values were seen as possible.

Strength increase with decreasing crystal dimensions began to climb sharply as whisker sizes were reduced below one ten-thousandth of an inch,

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from one paper, he said that "from the point of view of attitude control, a satellite or space vehicle is not a structure, but a precision instrument."

Space Communications

Use of balloons with antennas printed on them, which are inflated in space, was proposed in a paper by Maurice Chatelain of Convair Astronautics Division.

Citing that the angular concept can lead to design of broadband antennas, a spherical spiral antenna can fulfill this concept, Chatelain said. A design factor is proper relationship of circumference of the sphere and wavelength.

Space communications have several problems of their own which such an antenna would help to alleviate, he indicated, such as the attitude between transmitter and receiver being essentially transient, precluding accurate knowledge of the polarization. Another problem is Doppler shift, especially in lunar probes.

Space antennas must radiate heat as well as radio frequency signals, Chatelain said, indicating the proposed configuration should help in this area or be no worse than present antenna shapes and constructions.

Additionally, he said, a spherical antenna should receive radio signals with nearly all polarizations and within a very wide band of frequencies.

Another possibility for low frequencies is the column of ionized gases following the spacecraft which result from gas molecules colliding with the ship at high velocities.

These gases could very well be excited by probe or loop antennas, Chatelain said.

Propulsion Systems

Three basic propulsion systems for true space vehicles were listed by Dr. Milton U. Clauser of Space Technology Laboratories of Ramo-Wooldridge Corp., along with three types of particle accelerators.

Basic propulsion systems he listed as solar, using photon energy; nuclear fission, which requires a heat transfer system; and nuclear fusion, by which energy from the reaction can be much more efficiently used.

Research indicates that thermonuclear is most proinising when means to control the reaction are developed, Dr. Clauser said.

Three types of particle acceleration he outlined are electrostatic, electromagnetic (as in ion) and direct, whereby a heat transfer by convection, conduction or radiation is applied directly to the working fluid.

Optimization requires proper matching of these two elements, Dr. Clauser said, with the nuclear fusion and direct

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Hoffman said, and only in the past three years have whisker strengths finally been tested at levels near atomic cohesion strength. The effect has been noted in iron, carbon and many metals, also in such compounds as oxides, halides, carbides, also is noticeable in thin films and platelets of many materials.

Strength Theories

Theories explaining the strength include low incidence of edge dislocations, the restraining force on crystal surfaces. Strongest whiskers contain only screw dislocations, along their axis, and almost no edge dislocations. Growth mechanism of whisker tips has been explained by dislocation theory on assumption of a spiraling growth around a single screw dislocation, a fortuitous growth by orderly nucleation on the steps about a screw dislocation which almost eliminates the weakening edge dislocations.

Other notable properties of whiskers have been observed or inferred from assumed absence of edge dislocations including exhibition by whiskers of a plastic range while most compounds can sustain only elastic strains up to failure; creep has not been observed in whiskers below normal recrystallization temperature, implying considerable strength retention at elevated temperatures; modulus of elasticity of a whisker may differ radically from modulus of large polycrystalline amounts of same material, and can range from a halving to a doubling of polycrystalline modulus.

Customary density over ultimate tensile strength ratio of conventional material structures is supplanted by density over modulus of elasticity ratio for whisker design criteria. Investigation to date, Hoffman indicates, shows that the most promising room temperature whisker materials are the compound boron carbide and the metal beryllium.

Reduction Factors

With certain assumptions, Hoffman calculated structural properties of a beryllium-based whisker material and compared them with those of titanium. While first results indicated high weight reduction, Hoffman pointed out that certain deleterious effects could yield a more realistic reduction factor. Comparisons, he says, should include features peculiar to material under consideration, such as use of doublers, fastening problems, and fastening may be a very serious problem with whisker-based material.

Including design factors which lend a more realistic basis for comparison, Hoffman still concluded that weight reductions of the order of one-fifth those of present day materials could be obtained in such elements as cables, biaxially stressed sheets fastened so as to be removable, biaxially stressed and permanently fastened sheets, components in miscellaneous applications.

Mass production of whiskers may be effected by chemical reduction of metal halides, electrolytic deposition, vapor deposition, high stress, drawn micron-size filaments, in order to produce whiskers of needed quality, quantity and form. Collection can be accomplished by vibratory or mechanical scraping and alignment, thinness and length could be controlled by proper production saturations.

Harvested whiskers could be spun into fine strands like textiles, the strands woven into cables or sheets. Impregnation with a binder or pressing and heating could establish the final good shear bond between adjacent fibers to utilize whiskers strength, such as is currently done with glass fiber.

Human Factors

While pathological changes in animals have occurred in subjects exposed to radiation at high altitudes in balloons, such as a grey streak appearing on mouse fur, there is no somatic health hazard apparent with exposure to heavy primary cosmic radiation in exposures up to 24 hr., according to a paper prepared by Lt. Col. David G. Simons and

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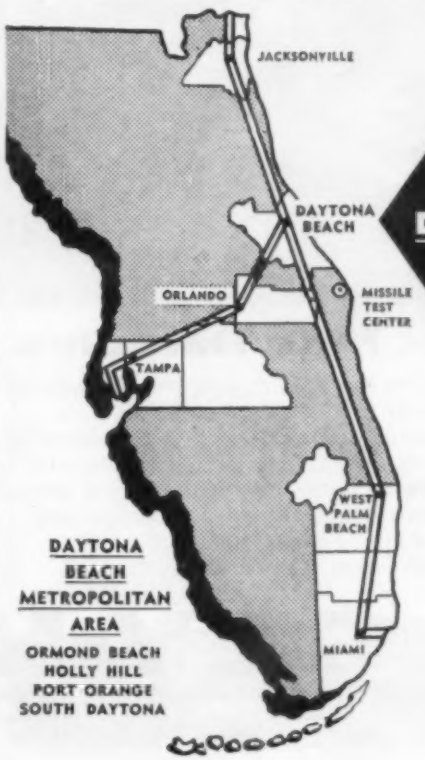

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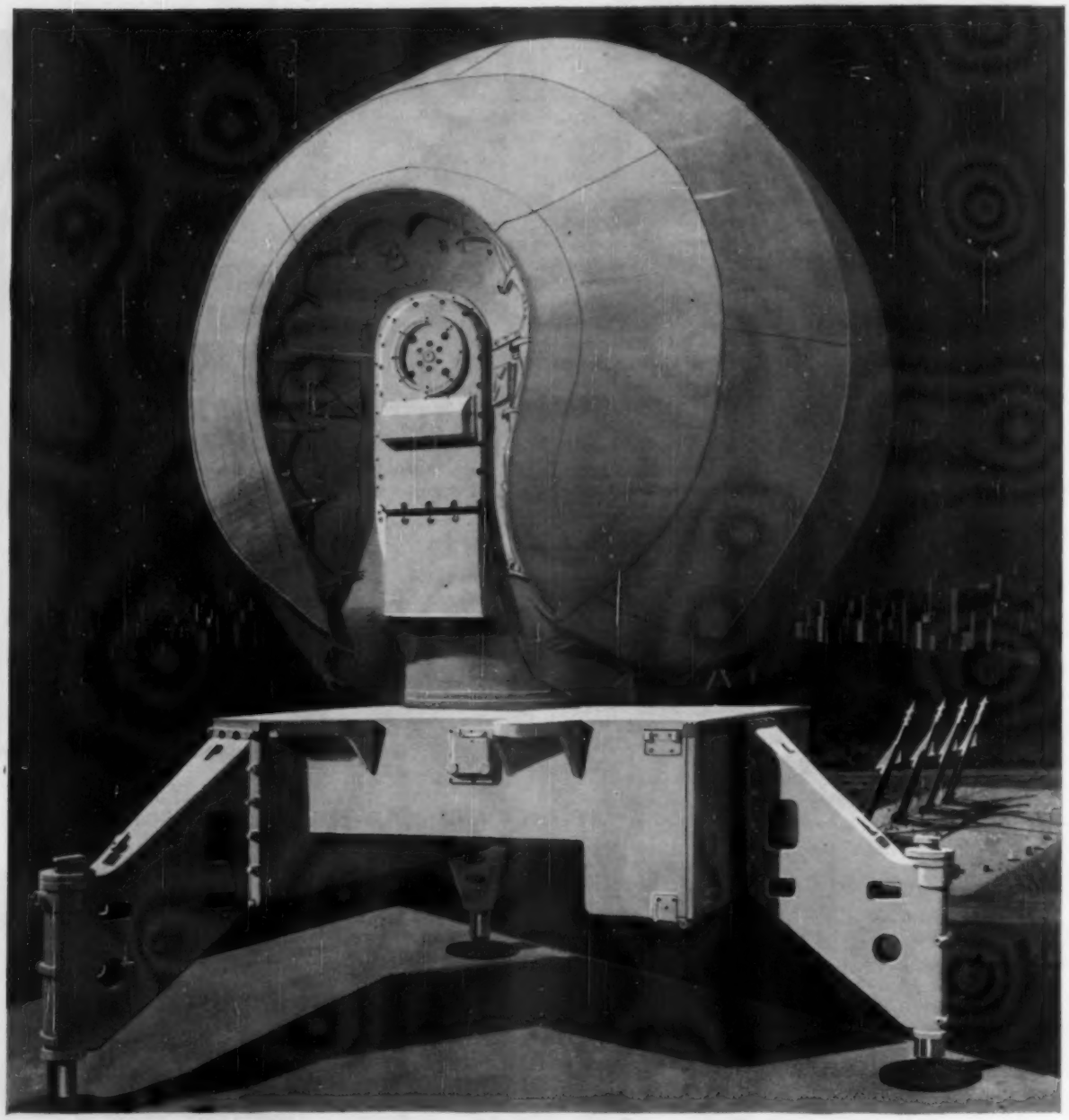
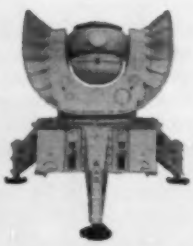


big ears of Nike Hercules

Mounts for radar antennae used by the U. S. Army's Nike Hercules to track aerial intruders and guide the deadly Nike missiles that strike them from the sky are products of the integrated manufacturing and engineering skills of Kelsey-Hayes, working in close cooperation with Western Electric. Capabilities range from prototyping to final production. The Speco Division is one of seven Kelsey-Hayes Divisions devoted to the production of aircraft and missile components.
Kelsey-Hayes Company, General Offices: Detroit 32, Michigan.



Nike Antenna Mount produced by Speco Division of Kelsey-Hayes requires over 2,000 individual parts, many of which are machined to a tolerance of less than two ten-thousandths of an inch.

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KH

High Energy Oxidizer

Perchlorial fluoride, a non-corrosive oxidizer which gives rocket propellant combinations almost the same performance improvement as fluorine is being produced in one-ton lots by Pennsalt Chemical Corp. Several service laboratories are testing the high energy oxidizer which can be stored safely under slight pressure and at temperatures below 300F.

Capt. James E. Cook of Holloman Air Development Center.

Neither has nerve cell damage due to this cause appeared, the paper went on to say, in outlining the various methods by which evidence of cosmic radiation was gathered. The paper reported on various experiments conducted in the field of radiation and its effects after prolonged exposure at high altitudes.

Concerning a closed ecological system (food-waste cycle), it was defined in a paper by Lt. Bruce W. Pinc of AFBMD, Inglewood, as a complex of mechanical, inorganic and organic subassemblies which independently maintain a principle inhabitant in a state of psycho-physiological homeostasis and permit useful operant performance.

These ends must be gained with negligible system constituent loss, maximized waste recovery and conversion, low weight, extremely high reliability and a high duration cycle.

Ecological Subcycles

Ecological subcycles in this ecological system must include nutrient subcycle, psycho-operant subcycle, ambient environment subcycle, according to Pinc, who added that no system meeting the definitional requirements has been constructed.

Although much work has been done with nutrient subcycle in biological waste conversion, reconstitution and reconstruction, this has been at laboratory bench level using relatively large amounts of power, weight and volume. Pinc went on to cite the work with green algae, noting the many deficiencies the material has as a sustainer of life and efficiency.

In the psycho-operant subcycle, things look better, Pinc concluded, with basic research well under way, although such questions as required knowledge for the crew, what instrument will best give him required knowledge, can he respond to this knowledge in weightlessness condition, still remain.

Pinc noted that while nutrient and psycho-operant subcycles need much work to become proven feasible, there will be no real requirement for their extended use until ambitious space flights are fully organized and begun. Presently, for forthcoming orbital flight, extensions of airplane techniques will probably be used, with waste controlled by diet, drugs and environment by stored gas and leakage control, Pinc stated.

Ambient environment subcycle faces many grave problems. While crewman can sustain a temporary nutritional imbalance and can undergo severe emotional trauma, he cannot long be denied adequate oxygen or be subjected for any length of time to an unacceptable level of carbon dioxide.

Arguments about total pressure provided and the relationship to airframe and launch requirements still rage, Pinc noted. Gas supply technique similarly is open to selection; whether to use stored gas or regenerative cycles. Measurement and control of gas partial pressures still leave something to be desired, he added.

Pinc summarized his outline with the premise that the whole answer to environmental control will be found not in biological laboratories but that some hard and original thinking must be done first by engineers about the basic problems of energy production, electronics, thermodynamics, solid, fluid and gas dynamics, mechanics and physical chemistry.

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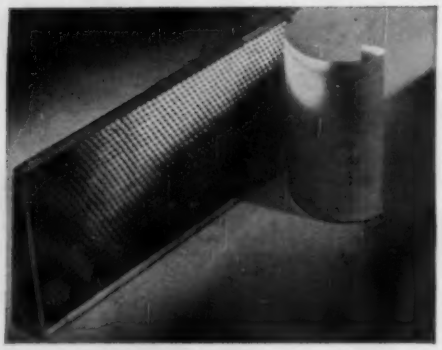

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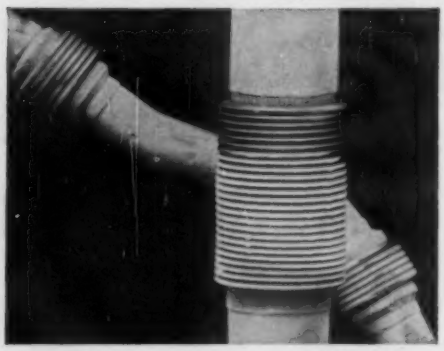

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Complete manufacturing and test facilities are also available for your important systems program. For detailed information about Solar's systems capabilities, or about any of the areas mentioned above, write to Dept. F-60, Solar Aircraft Company, San Diego 12, California.

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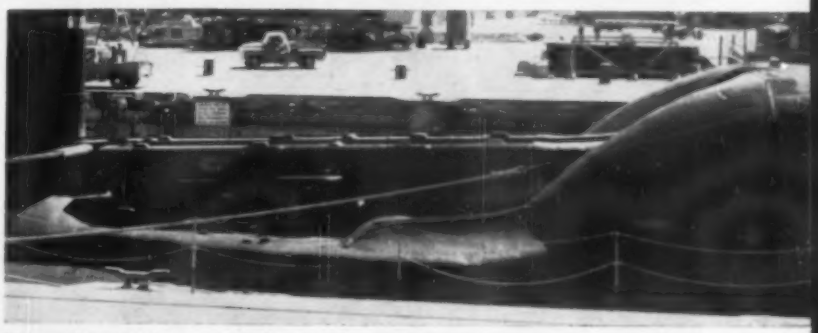
How Submarine Fires Regulus II

Regulus II guided missile pre-firing drills are under way aboard the submarine USS Grayback at Mare Island Naval Shipyard, Vallejo, Calif. Submarine is fitted with special forward deck hangars which house the missile. In the pre-launch cycle, carried on at dockside, Regulus II was removed from one of the two forward missile hangars. When clear of hangar doors, the Regulus II wings, tail and nose boom were unfolded and secured in flight position. In flight configuration, the missile's General Electric J97 turbine engine was started and run to partial power. Crew training sequence ran to the point where the solid rocket booster would have been fired to actually launch the vehicle. Although photos show a cluster of men on Grayback deck, the firing is largely an automatic procedure handled from a control room inside the submarine. Regulus II comes out of deck hangar on special mount, is swiveled to the side and then fired from the deck (AW June 23, p. 63). Chance Vought Aircraft missile utilizes an Aerojet-General rocket booster; J79 engine then produces about 10,000 lb. thrust.



Hangar doors (right) are closed as exercise starts; missile leaves port hangar (below).

Nose boom, wings are folded (left) and in flight position (right). Missile's J79 engine is run-up (below), ending exercise.

Australian Malkara Missile Nears Tests

London—About 30 Australian Malkara anti-tank guided missiles will be fired in tests on a missile range on the Solway coast of Scotland next month. Lt. Col. H. S. Long, of the Research Development Establishment, Kircudbrightshire, said it is unlikely that Malkaras will be fitted with explosive warheads for tests. Missile is a 200 lb. ground-to-ground radio controlled weapon (AW August 18, p. 37).

Britain has ordered 160 Malkaras from Australia. Existence of the weapon was disclosed by Aubrey Jones, Minister of Supply, during a visit to Melbourne. The minister gave details of a contract worth $4,480,000 for 160 Malkaras and 50 Jindivik target aircraft.

Malkara was developed by Australia at Government Aircraft Factory, Melbourne. It can be used against tanks, pill boxes, landing craft and small ships. It is launched from a mobile platform.

Canadair to Produce Sparrow II Missile

Ottawa—Canadian government will spend $14 million this year on production of the Douglas Sparrow II air-to-air guided missile.

Canadair Ltd. is producing the Sparrow II for use on the Avro Arrow CF-105 jet fighter. Company previously received an $8 million preproduction planning and engineering contract for the missile. Tooling costs will amount to about $2.5 million.

In other Royal Canadian Air Force contracts, a total of $169 million will be spent for production of 23 Canadair CL-28 Argus anti-submarine warfare aircraft. Price includes engineering and development costs.

Canadair also has received a $24 million contract for production of eight CL-44 transports. Aircraft is a derivative of the Bristol Britannia airliner. The company also has received $8 million for CL-44 engineering work, plus $10.1 million for tooling costs.

PRODUCTION BRIEFING

Westinghouse Electric Corp., Los Angeles, Calif., will build electrical equipment to power retractable shelters for the Thor missile under $1,750,000 contract. Shelter, enclosing horizontally positioned missile, is equipped to roll back the length of the missile prior to erecting and firing.

AiResearch Division of Garret Corp., Phoenix, Ariz., will develop component systems on the Atlas IBM under $1 million contract.

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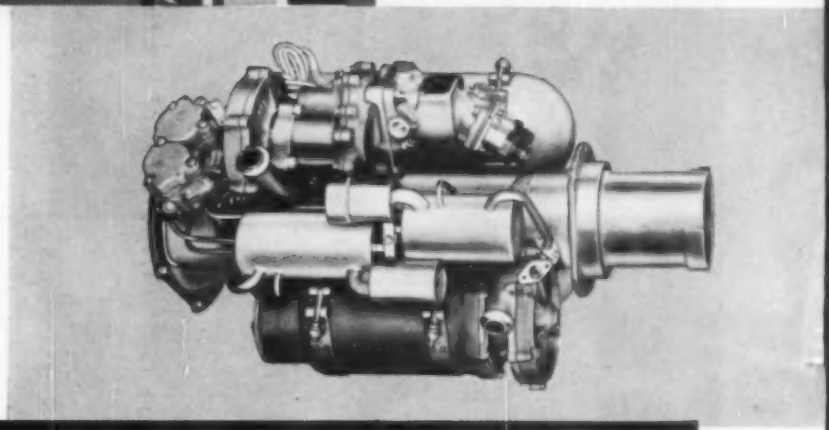
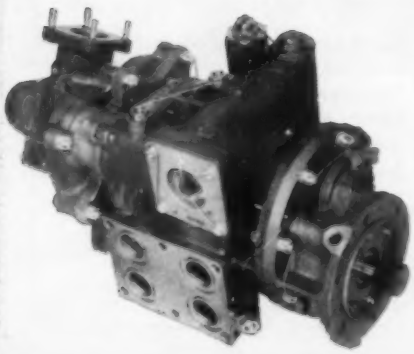
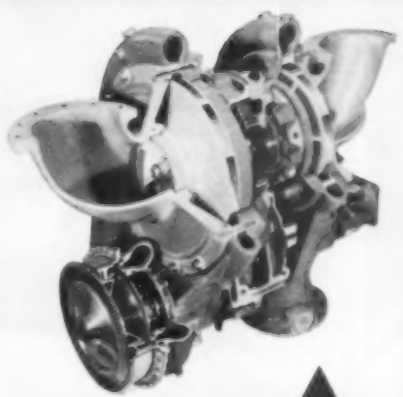




At left: Combination main and afterburner engine-driven fuel pump now providing thousands of hours of trouble-free service in production fighter aircraft.

At right: Rocket engine turbo pump now in production at Tapco for use in several of America's leading missiles.



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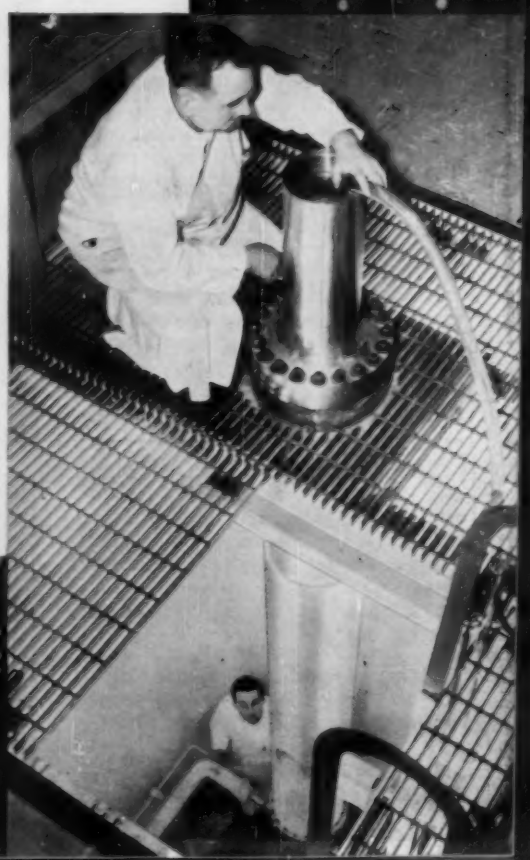
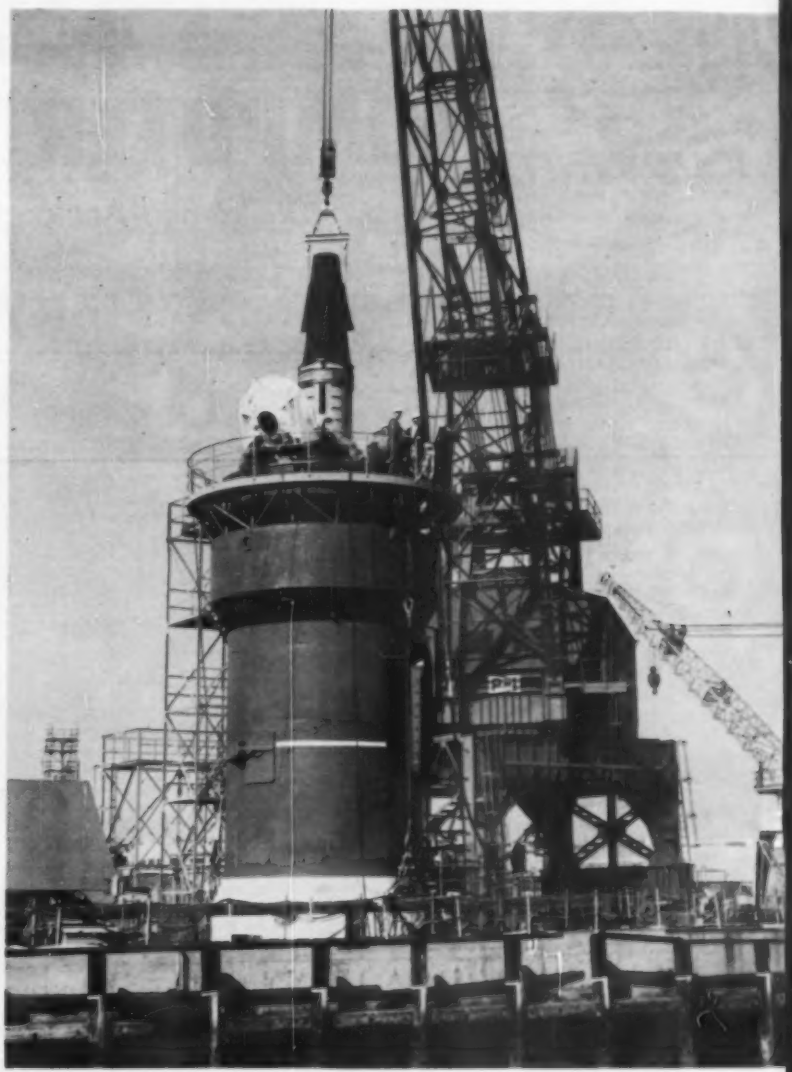


Function testing of nuclear reactor control rod drive mechanisms ▶ in a simulated vessel head; part of Tapco's continuing research project on nuclear reactor components and control systems.

Submerged Tube Launches Polaris In Navy Tests

Technique for launching the Lockheed Polaris fleet ballistic missile from underwater is being tested near San Clemente Island off southern California by the U. S. Naval Ordnance Test Station (AW April 21, p. 31). An inert Polaris missile is loaded into a launching tube which is pulled down to a launching pad on the ocean floor by winches operated from shore. The underwater launching tests are recorded in detail by sonar and camera instrumentation positioned beneath the ocean surface, and connected to a monitor barge in the test area.

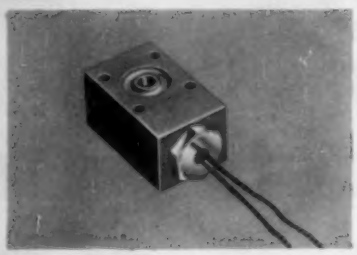
Skin diver works on net at Polaris underwater launching test site. Nets are designed to catch inert Polaris missile as it falls back in ocean after being launched.



Navy's Lockheed Polaris fleet ballistic missile is lowered into a launching tube which will be towed to San Clemente Island sea ranges of the U. S. Naval Ordnance Test Station where underwater launching tests will be made.

Inert Polaris missile rises from ocean's surface after being launched from underwater tube at San Clemente Island test area.

NWL EXPLOSIVE ACTUATED VALVES



reliable solution for the most critical hydraulic and pneumatic problems

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Backed by proven engineering abilities and precision manufacturing facilities, these NWL one-shot explosive actuated valves are designed for the most exacting applications of hydraulic and pneumatic mechanisms. For a fast, sure answer to *your* problem—

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COMPUTER PROGRESS

Digital and Analog Computers at Work

ARTICLE 3 VOLUME 1

NEW ELECTRONIC HEAT RATE COMPUTER HELPS SLICE THROUGH AIRCRAFT "HEAT WALL"

This latest General Electric Computer helps simulate aerodynamic heating encountered in flight by high speed aircraft. Compression of air around an airframe increases air temperature. The temperature rise can be calculated from wind tunnel test data taken from scale models. Stresses created by artificially heating actual airframe sections in a high temperature test laboratory are then analyzed to aid in structure design. The Heat Rate Computer not only *calculates* the amount of electrical energy required by banks of infra-red lamps or other heat sources, but also *controls* the energy flow.

Calculation of the heat flow necessary for accurate simulation can be made by satisfying the thermal equilibrium equation:

$$Q = A\left[h(T_{aw} - T_s) - BT_s^4\right]$$

where: Q = heat rate (BTU/hr)
A = area (sq. ft.)
h = heat transfer coefficient (BTU/hr., sq. ft., °R)
T_{aw} = adiabatic wall temperature (°R)
T_s = surface temperature of structure (°R)
B = radiation factor (BTU/hr., sq. ft., °R⁴)

The Heat Rate Computer solves this equation instantaneously using both digital and analog techniques, then sends energy to the heat source at the proper heat rate, Q. Transducers mounted on the airframe provide the feedback signal proportional to T_s.

One large computing system has been designed by General Electric to calculate and control the heat flow to 39 airfoil areas. The unique use of a magnetic drum to digitally store T_{aw} and h curves insures freedom from drift and permits easy storage of, and rapid access to curve data. Multiplexing and time-sharing minimize the amount of electronic circuitry.

COMPUTER DEPARTMENT LAUNCHES OPERATION UPTURN WITH NEW MILLION-DOLLAR PLANT IN PHOENIX, ARIZONA

General Manager H. R. Oldfield, Jr., is pictured at the controls of the Operation Upturn steam shovel which recently broke ground for the new 104,000 square foot permanent plant which is expected to be completed by December of 1958.

"Our business is good and getting better," Oldfield said. "We're going to continue to expand during the year, adding perhaps a hundred or more people." The department now has over 800 employees.

The 160 acre site is located in Deer Valley Park, northwest of Phoenix along the west side of the Black Canyon Highway and south of the intersection with Thunderbird Road.

COMPUTING SERVICES GROUP HANDLES COMPLEX ORIGIN-DESTINATION STUDY FOR WESTERN CITY

The Computing Services Center of the G-E Computer Department recently completed an origin-destination tabulation for the Phoenix-Maricopa County Traffic Study Group in Phoenix, Arizona. The results of this tabulation, when analyzed, will enable the group to plan the street and highway development program of this desert metropolis for years to come.

The original survey information was obtained by the city-county personnel using the interviewing procedures set up by the U. S. Bureau of Public Roads. The data was put on punched cards and then turned over to G-E for processing and tabulation.

Using manual, or simple computing methods, such tabulations often take many months—sometimes years—to complete. However, using the Computing Services Center Computer on a rental basis, the job was completed in just a few weeks. The Computer Department also performed the difficult programming job.

(Programming, simply stated, is the translation of the solution method into the language a computer can understand, and the issuance of instructions to the computer so that it will process the information it is fed.)

The Computing Services Center of G-E's Computer Department is staffed with 125 analysts, programmers, coders —all leaders in the computer field. Their services are available, along with time on the large and versatile type 704 computer, to handle the problems of industry, business, government and education.

For more information contact your nearest Apparatus Sales Office, or Computer Department – Room 101, General Electric Company, 1103 North Central Avenue, Phoenix, Arizona.

CPA–7

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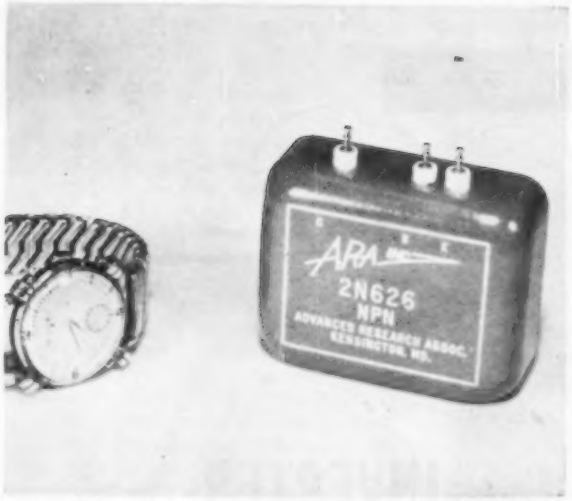
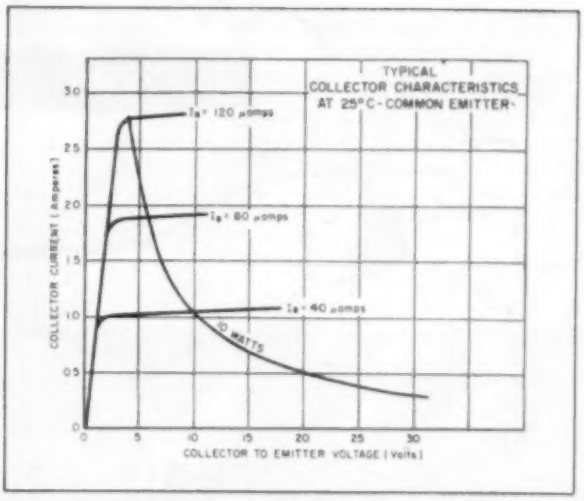




COMPOSITE-TRANSISTOR, novel semiconductor amplifier (left), provides current gain of 15,000 to 30,000 with built-in temperature compensation. The device has 10 junctions compared with two of the conventional transistor. Typical performance curve is at right.

Composite-Transistor Offers High Gain

By Philip J. Klass

Kensington, Md.—Composite-transistor, novel semiconductor device which exhibits the high input impedance of a small-signal transistor, the low output impedance of a power transistor and the over-all current gain (15,000 to 30,000) of a cascaded amplifier, has been developed here by Advanced Research Associates, Inc.

Composite-transistor is available in conventional PNP and NPN types, as well as two novel PNN and NPP configurations not found in ordinary transistors. The device also boasts built-in compensation which reportedly enables it to operate at higher temperatures.

New device consists of three junction transistors connected in cascade, plus several diodes and/or transistors required for temperature stabilization. Whereas a conventional junction transistor has two junctions, the composite-transistor has total of around 10. There are no resistors, capacitors or other non-semiconductor elements. Transistors and diodes used are obtained from a variety of established semiconductor manufacturers, but are suitably matched and interconnected by Advanced Research Associates.

At present, collection of semiconductors is mounted and encapsulated inside a case measuring 2½ x 2 x ⅞ in. There are three input-output terminals, corresponding to the emitter, collector and base leads of a single conventional transistor. When the designer applies an Advanced Research Associates composite-transistor to a specific circuit requirement, he can treat the device as if it were a conventional transistor, except that his task is simplified by the built-in temperature compensation.

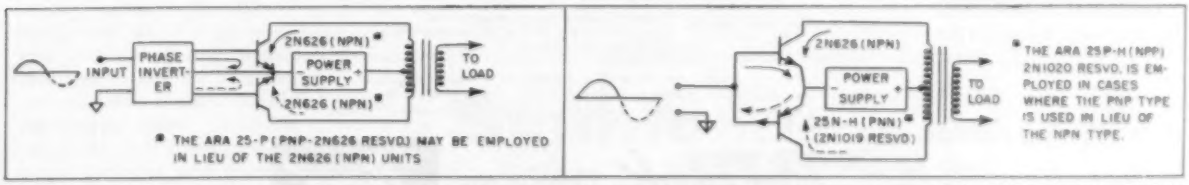
Is It a Transistor?

Some observers object to calling the Advanced Research Associates device a transistor, say it should more properly be called a transistor amplifier. In its present form, consisting of conventional transistors and diodes with leads soldered together, the device does resemble a small amplifier before it has been encapsulated and encased.

But Norman K. Walker, Advanced Research Associates president, points out that if the composite-transistor concept were adopted by a semiconductor manufacturer, the collection of junctions could be fabricated within a single envelope, possibly not much larger than present conventional units. If this were to happen, the device would then more closely resemble a conventional transistor than an amplifier.

Fact that the device employs more than two junctions of a conventional transistor is no reason for denying it the name of transistor, Walker points out. He cites, for example, the PNPN and tetrode semiconductor devices which have three junctions, and four-junction units with two crystals connected in tandem, all of which go by the name of transistors.

The company's case proved sufficiently convincing that Electronic Industries Assn. has given official JETEC transistor designation of 2N626 to ARA's first composite transistor which is now in pilot production. Walker emphasizes that ARA lays no claim to having conceived the idea of composite-transistors, but believes it is the first


INPUT
PHASE INVERTER
2N626 (NPN) *
POWER SUPPLY
2N626 (NPN) *
TO LOAD
* THE ARA 25-P (PNP-2N626 RESVD) MAY BE EMPLOYED IN LIEU OF THE 2N626 (NPN) UNITS
2N626 (NPN)
POWER SUPPLY
25N-H (PNN) *
(2N1019 RESVD)
TO LOAD
* THE ARA 25P-H (NPP) 2N1020 RESVD. IS EMPLOYED IN CASES WHERE THE PNP TYPE IS USED IN LIEU OF THE NPN TYPE.

UNUSUAL PNN or NPP type composite-transistor with reverse polarity emitter-base current flow, when paired with conventional NPN or PNP type, makes it possible to eliminate phase inverter stage (left) in an a.c. push-pull amplifier, as shown in the circuit at right.

BENDIX STATIC INVERTER

Voltage and Frequency regulated power supply

A real "blessed event" is coming your way soon—the new Bendix AC-Pak*. And it'll be a knockout! It's fully regulated for voltage and frequency—and is built to give thousands of hours of efficient, trouble-free operation with minimum maintenance.

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Right now it's still undergoing rigorous tests. When it proves itself completely, then, and only then, it will be ready for market.

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Units capable of operating over an input voltage spread of 14-37 volts can be supplied at a weight penalty of 25%.

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250 VA	115/200	3	80	8
500 VA	115/200	3	82	12
1000 VA	115	1	83	16
1000 VA	115/200	3	83	19
3000 VA	115/200	3	85	32

Voltage Regulation ±1% **Frequency Regulation ±0.25%**
Total R. M. S. harmonic content under all conditions 2.5% max.
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For short-life applications such as missiles, circuits are stable to 110°C chassis temperature.

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to offer such units on the market. If the idea of composite-transistors catches on and semiconductor manufacturers adopt it, the device may have as much impact as the development of the multiple-function vacuum tube several decades ago. At the moment, however, most of the major transistor manufacturers show no outward signs of plans to move into the field.

Design of transistor circuits is complicated by the fact that conventional transistor characteristics change markedly with changes in collector junction temperature, which depends upon the magnitude of collector current and ambient temperature.

An increase in ambient temperature will produce an increase in leakage current across the collector junction, which in turn raises junction temperature, causing more leakage current to flow, which in turn raises the temperature. In the extreme case, this can produce a runaway condition which destroys the transistor junction.

To minimize effects of changes in ambient temperature, circuit designers must operate transistors at conservative current levels and usually provide some sort of thermal compensation in their circuits. Working out compensation circuitry can be time-consuming.

The Advanced Research Associates composite-transistor has its own built-in thermal compensation circuitry, utilizing diodes and transistors which reportedly do not restrict amplifier's dynamic range. Techniques were developed by Henri Hoge, ARA's chief of research and development. This feature not only simplifies application of composite-transistors to equipment design, but permits germanium units to be rated for operation at ambient temperatures up to 75C, Hoge says. Company is tight-lipped about circuit details because of patent applications on file but not yet granted.

Here are some of the characteristics of the 2N626 composite-transistor, based on company data:

- **Current gain:** 18,000 to 30,000, for collector current of one ampere, collector-emitter voltage of 5 v.
- **Small signal input impedance:** 2,000 ohms, for collector current of one ampere collector-emitter voltage of 5 v., signal frequency of 1 kc.
- **Max. power dissipation:** 10 watts.
- **Max. collector current:** 3 amp.
- **Frequency cutoff:** 7 kc. minimum.

Present upper limit for cutoff frequency is set by frequency limit of currently available output power transistors. New units soon to be available from Texas Instruments are expected to permit considerable increase in cutoff frequency, Hoge says.

Three other types of composite-

Anti-Noise Earphones

Earphones designed to cancel outside noise, employ small microphone (lower device) inside headset which picks up ambient noise that leaks through ear cushion. Phase of this noise is reversed and combined with incoming radio message in sound reproducing element (upper device) to effectively cancel out effect of ambient noise. Experimental earphones were developed by Radio Corporation of America and Army Signal Research & Development Laboratory.

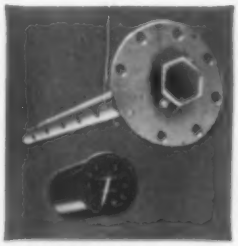
both indicator and amplifier in one housing . . . only 2.2 inches long

. . . **smallest PACITRON unit is biggest fuel gaging news . . .**

Simmonds now offers the newest addition to its famous PACITRON Fuel Gage family . . . a small lightweight *transistorized* fuel gage for military and transport aircraft. It is highly dependable and accurate. The replacement of vacuum tubes by transistors permits Simmonds to incorporate amplifier-bridge and indicator into a single smaller unit, saving space and weight.

Simmonds packages three types of PACITRON Fuel Gage systems, custom-built for every requirement: the new 2-unit transistorized gage, the well-known 2-unit vacuum tube gage, and the lightweight 3-unit system. Along with dependable fuel measurement, *ALL* PACITRON systems provide important fuel *management* functions such as Center of Gravity Control, Level Switching, Totalization, Telemetering and Load Limit Control. All systems meet MIL specs.

Complete information on all the above systems is available on request.



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Can anyone build a missile?

Theoretically, yes! Today, even the sandlot Leonardos and knee-pants astronauts are building them.

The problem in this business is to stay ahead of the game, working today on the programs that mark the way into the future. The end result—five to ten years later—must be far more than a missile. It must be a complete operational system, integrally engineered from concept to completion of the mission; produced in facilities totally integrated for designing, building and testing by engineers and scientists who know and understand the problems and requirements of the military. The payoff is in full payload performance in the field—time after time—with military personnel setting it up, proving it out, and operating the controls.

For the creation of today's most advanced missiles and the big space vehicles that are now in the planning stage, Martin capabilities are among the finest in the world. They are the result of a planned program of manpower and facilities development which commenced nearly fifteen years ago with the opening guns of the U.S. Missile Age.

MARTIN

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transistors have been developed by ARA, but their design has not yet been frozen, which explains why the company has not yet obtained JETEC designations for them. These units include:

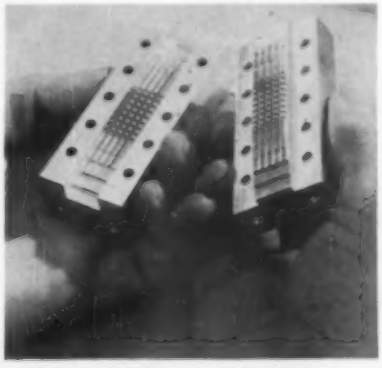
• **ARA-25P:** PNP transistor, with current gain of about 15,000, input impedance of around 5,000 ohms, cutoff frequency of 7 kc. minimum, also rated 3 amp.

• **ARA-25N-H, ARA-25P-H:** These are PNN and NPP transistors, respectively with current gains of 15,000, input impedance of 2,000 ohms and cutoff frequency of 7 kc. minimum, rated for 10 watts maximum power dissipation, 3 watts maximum collector current.

Novelty of the latter units is the fact that current flow between emitter and base is opposite that of conventional PNP and NPN units. This provides complementary units which can be combined with PNP and NPN transistors to give novel circuit designs.

For example, in an a.c. push-pull amplifier, a 2N626 (NPN) unit can be combined with the PNN unit, to provide the push-pull amplification and to eliminate the need for a separate phase inverter.

Advanced Research Associates also has developed a shunt-regulating diode, type ARA-D1528, designed to protect transistorized equipment against momentary surges of d.c. line voltages above 28 volts. The device, measuring 2 x 1½ x 1½ in., contains a Zener diode in combination with a composite-transistor. When connected across 28 v.d.c. input terminals of a transistorized equipment, device serves as a shunt capable of absorbing up to 15 amp. and preventing voltage applied to the



Microwave Filter

New "waffle-iron" microwave filter for waveguides, developed by Stanford Research Institute for Hewlett-Packard Co., Palo Alto, Calif., reportedly is easier to fabricate and occupies less space than previous waveguide filters. Unit shown has a 10 to 15.5 kilomegacycle (kmc.) passband. Similar design has been developed for 26.5 to 41 kmc.

The World's Largest More Than 20,000

SUPT. OF MAINTENANCE Roy Palmer says, "I'm sold on ACs! Our service records prove their reliability and performance!"

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Executive Fleet Logs Flying Hours Annually!

Youngstown Airways Incorporated — "The World's Largest Executive Fleet" — furnishes executive planes on lease to an impressive list of customers on the American business scene!

"With the important contracts we have, we must use the most reliable plug available," *says Roy Palmer.* "The AC SR-83P platinum electrode Spark Plug has cured our lead problems. In the past, we had lead on plugs as early as ten hours after they were cleaned. But with ACs, we have had less than half-a-dozen pre-removals before 100 hours of flying time. That's why we're sold on ACs!"

Consider the fact that Youngstown Airways exceeds 20,000 flight hours per year in its total fleet of 35 to 38 Beechcrafts, and the importance of spark plug reliability and performance is readily recognized. Today, 28 planes in this fleet are leased by 26 customers who demand on-time departures and arrivals.

If you're a one-plane or multi-plane operator, profit from Youngstown Airways' experience — install AC Aircraft Spark Plugs! Get them from your AC Supplier.

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equipment from exceeding 29½ v., according to Walker.

Advanced Research Associates currently is working on a composite-transistor which is expected to be able to control load currents of 200 amp. or more from low-level signal applied to its terminals.

Price of ARA composite-transistors runs between approximately $112 and $175, depending upon type and quantity ordered. The shunt-regulating diode price ranges between $87.50 and $125. A number of companies have bought composite-transistors for evaluation, Walker says.

Advanced Research Associates was formed little more than a year ago by Walker, former engineer in the missile guidance section at Britain's Royal Aircraft Establishment, and Don Widmayer, company vice president. Prior to coming to the United States with Joint Services Commission in 1954, Walker had developed a line of radio controls for drones. This was the first line of endeavor which ARA tackled after it was formed.

The company has developed a number of miniature, high efficiency rotary and linear actuators as well as related transistorized servo controls. Customers include the National Advisory Committee for Aeronautics and Radioplane. The new composite-transistor is an outgrowth of ARA's efforts to develop miniaturized transistor amplifiers for use in its drone/model aircraft radio control systems.

Company now has about 20 full-time employes, plus five outside consulting engineers on a part-time basis. If interest of a major avionics manufacturer in using composite-transistors for high-production defense equipment develops into an order, the company expects a major expansion.

Advanced Research Associates address: P.O. Box 68, Kensington, Md.

British Plan Four ATC Radar Points

London—Further details have been released on Britain's five-year-plan to modernize its air traffic control system. The plan, authorized by the Ministry of Transport and Civil Aviation, will cost about $15 million.

Beginning this year, the plan foresees new long range radar stations at four strategic points—southeast England, Manchester, the west country, and near Prestwick, Scotland. At these stations, electronic equipment will receive, store and display information required by the air controllers.

Feature of the plan, due to increasing traffic and lack of airspace over Britain, is the decision to reduce the amount of radio communication between aircraft and ground. This results in an extension of the ATC ground radar coverage. The four new radar stations will have a low level range of 85 mi. and a high level range well over 100 mi.

Radar information will be automatically sent by three joint civil-military ATC centers in London, central England and Scotland. In the initial stages the information will be displayed on plan position indicators but later displays will remove "clutter" and unwanted echoes and show in addition individual aircraft identity and heights. An electronic store will automatically feed each individual controller with the pertinent information on his sector.

In parallel Ministry plans to introduce semi-automatic control equipment for handling of flight plans submitted to the air traffic controller prior to departure. The ultimate aim—complete mechanization of flight plan handling within the air traffic control organization.

Electronics industry has already submitted to the Ministry detailed proposals for the four new radar stations while the MTCA in its air traffic control experimental unit is studying the requirements of the second phase, the development of suitable information display systems.

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Now, LORAN becomes an even more practical navigation system, with the development by Edo of a simplified, lightweight, *pilot-operated* unit. This compact equipment, weighing only 26 pounds installed, can be mounted in the cockpit. From it the pilot obtains directly read line-of-position information, without having to consult tables or make complicated calculations.

Thoroughly tested in trans-oceanic operation, Edo LORAN has been ordered by Pan-American, BOAC, Qantas, Cubana, Air France, KLM and Sabena for installation in their upcoming fleets of jet aircraft. Many other international carriers have also indicated their intention to use LORAN to assure precise, reliable long range navigation.

EDO AIRBORNE LORAN, Model 345

Control panel and 3-inch scope are mounted in cockpit for operation by pilot or co-pilot. Receiver (left) occupies ¾ ATR rack. Installed weight of complete system is only 26 lbs., and compact unit requires only a small fraction of space formerly required. Designed and manufactured by Edo, a major supplier of advanced electronic systems for the U.S. Navy—sonar, radar, ASW equipment.

For the complete data on Edo Model 345 Airborne Loran send for Technical Manual #501, Dept. C-7.

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STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

I've been asked whether non-aeronautical engineers have good prospects for advancement in the aviation industry.

The answer is *yes, definitely!* At Douglas many of our top supervisory people have moved up from other engineering specialties. The complexity of modern aircraft and missiles requires the greatest variety of engineering skills known to industry.

For example, we now have pressing needs for mechanical, structural, electrical and electronics engineers in addition to aerodynamicists, physicists and mathematicians. Whatever your background in the engineering profession may be, there are prime opportunities in the stimulating aircraft and missiles field.

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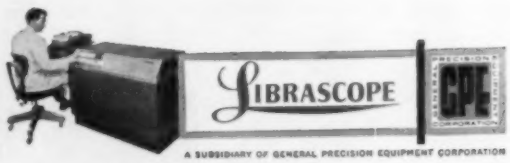

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Nine-In-One

Multi-function flight instrument, Model 4087, combines nine display functions in single indicator. List includes: omnirange course selection, reciprocal course, lateral course deviation, localizer and glide slope indicators, "To-From" indicator, glide slope and localizer alarm flags, and heading changes. Unit weighs little over one pound. Lear, Inc., LearCal Division, Santa Monica, Calif.

Chance Vought Forms Avionics Department

Dallas—Chance Vought Aircraft Inc., has formed a new Electronics Engineering Department to manage avionic systems going into the company's fighters and missiles and to do basic electronic research and development.

Electronics activity has been consolidated in one department under the direction of Dr. James F. Reagan, Chief Engineer-Electronics Engineering Department.

The new group has about 500 employes, including 350 engineers, and Chance Vought says the department will be expanded in the immediate future to strengthen current capabilities and acquire new capabilities.

Formation of the new department reflects the growth in electronics activity at Chance Vought since 1951 when 20 employes were involved in the field.

Now the company maufactures about 5% of all the electronic equipment which goes into the Crusader aircraft and Regulus missiles.

Electronic Engineering Department will manage current aircraft and missile electronics systems, and it will participate in Chance Vought's share of the Boeing Dyna-Soar project.

Earlier this year, Chance Vought moved into the field of commercial electronics when it formed the Genesys Corp. in Los Angeles, Calif. This wholly-owned subsidiary specializes in the design, development and production of advanced computer systems, components and allied products, with the emphasis on commercial and industrial applications.

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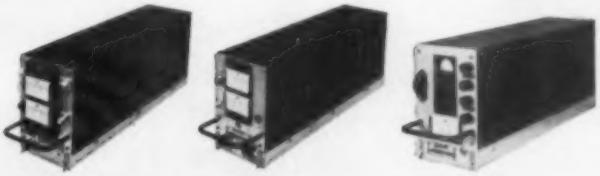

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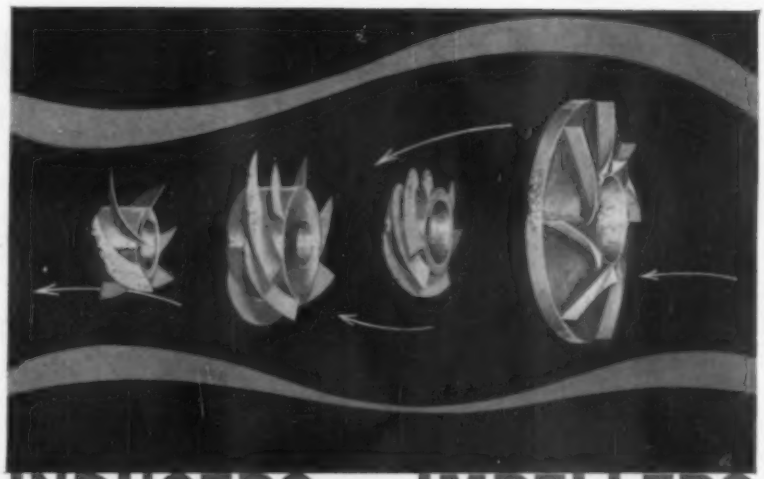

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TURBINE-POWERED S-62 can water-taxi up to 15 kt.; turns 360 deg. in its own length. Aluminum hull incorporates five compartments.

Aviation Week Pilot Report

Turbine Cuts Noise, Adds to Simplicity and

By Robert I. Stanfield

Bridgeport, Conn.—Effectiveness of its new flying boat type hull and lightweight gas turbine engine is reflected in the good water handling and flight characteristics of Sikorsky's amphibious S-62 helicopter.

Prototype S-62—currently powered by YT58-GE-6 engine—also evidenced relative quietness and lack of vibration during flight evaluation by AVIATION WEEK, the first such report on a U. S. turbine helicopter.

Turbine-powered helicopter combines the dynamic parts of Sikorsky's S-55, including the main rotor head, with the General Electric T58 or Lycoming T53 engines and a new fuselage.

S-62 is up to 898 lb. lighter (empty weight) than the piston-driven S-55 (AW Jan. 20, p. 96).

Transmission system is rated at 670 hp. at the input to the main gearbox. This is based on the S-55's R1300 engine output of 700 hp., less the difference between piston engine fan losses and gear losses in the new input section. Sikorsky is in the process of changing the YT58 fuel control unit so that full power of engine—1,025 hp.—will be available, thus reducing power losses in hot weather.

S-62 Performance

Evaluation pointed up these key features of the S-62A:

• **Controllability.** Helicopter is sensitive to light control forces; response was quick in all flight regimes. Main lateral servos are similar to those of the S-55; there is no mechanical feedback.

• **Water Handling.** Autorotations were made over Long Island Sound from 1,000 ft. Wind was from the southeast at 10 kt., swells were about 2 ft. Water contacts were light to moderate. There was no tendency to roll or dig in. The S-62 was taxied into 360 deg. tight turns, riding solid in water.

• **Turbine power.** Both the T58 and T53 are capable of delivering the full transmission rating of 670 hp. at ambient temperatures up to 104F. For standard conditions, the T58 is rated at 1,050 shp. military and 900 shp. normal continuous; the T53 is rated 900 shp. military and 825 shp. normal continuous.

While power on the production engine is presently limited by the transmission, the B model of the S-62, which Sikorsky expects to fly early next year, will incorporate the S-58 rotor system and a new gearbox. Upgrading of the T58 engine is expected to produce up

THROTTLE quadrant and overhead panel are easily accessible to both pilots.

HELICOPTER'S hull is stressed to operate off water continuously. Three watertight compartments form stabilizing sponsons.

Power in S-62

to 1,250 hp. Normal cruise speed is estimated at 125 kt., as compared with 90 kt. for the S-62A.

Prototype flown during evaluation was N880. Along with AVIATION WEEK pilot was Sikorsky engineering pilot Frank Yirrell and two passengers. Basic weight of aircraft, with instrumentation, was 4,788 lb. With complement of four, plus 1,150 lb. of fuel (182 gal. of JP-4) and 33 lb. of oil, helicopter's gross weight was about 6,700 lb. Maximum allowable gross weight is 7,500 lb.

Cabin was entered through 4 x 5 ft. sliding center door on pilot's (right) side. Interior was bare, but is large enough for nine to 12 passengers or six litter patients, plus four sitting patients and an attendant. Cabin measures 14 ft. long by 5 ft. 4 in. wide and is 6 ft. high.

Cockpit is roomy and comfortable, with large glass area that affords excellent forward and down vision. Looking straight ahead, pilot gets 18¼ deg. upward visibility and 23¼ deg. downward visibility. Quartering side panels at floor-to-knee level give further downward vision, and there is an extra ceiling

S-62 ENGINE and flight instruments are mounted ahead of pilot. Dual instrumentation is optional. Included are dual collective and cyclic controls.

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panel for additional upward vision.

Helicopter was provided with dual collective and cyclic controls. Overhead panel, directly between pilots, contained instrument lighting rheostat switches, starting switches and fire emergency shut-off selector. Directly behind was circuit breaker panel. Ahead, at top windshield level, was throttle quadrant.

Engine and flight instrumentation was paneled on right side; dual instrumentation can be provided at option of buyer. Emergency or "caution" warning panel is mounted on left of main panel. Instrumentation included airspeed indicator, flight indicator, altimeter, gyrosyn compass, turbine rotor tachometer, rate of climb, bank and turn, and clock.

Gages included exhaust temperature, gas generator rpm., fuel pressure and engine oil pressure, transmission temperature and oil pressure, primary and utility hydraulic pressure, and engine oil temperature. Radio and landing gear controls, parking brake and tail wheel lock are located on pedestal directly below, easily accessible to both pilots.

Starting Procedure

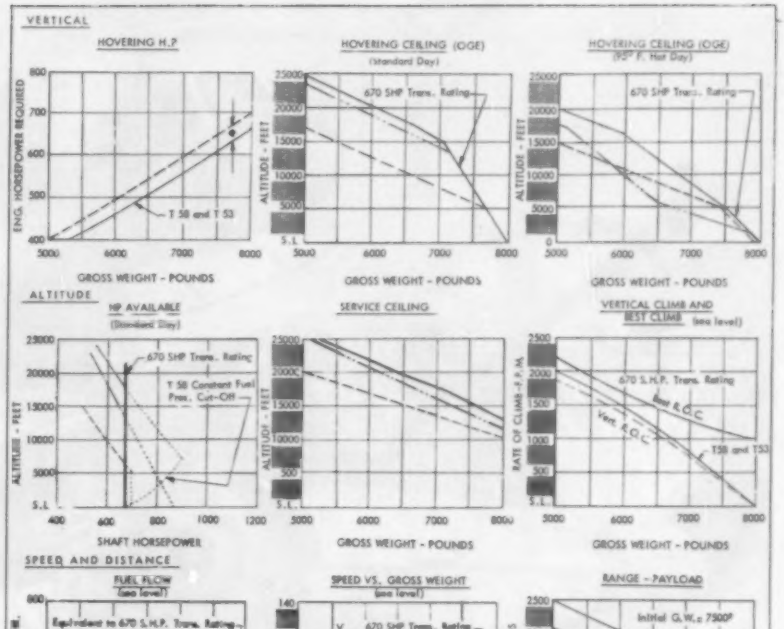
Once started, the turbine engine needs no pre-flight warm-up. And the starting is automatic and simple: throttle is advanced, start switch depressed and throttle retarded to stopcock position; then engine motors and igniter start firing. At 10% engine speed (gas generator rpm.) throttle is advanced to idle, bringing in fuel. Engine fired at about 20% gas generator rpm. and accelerated to idle, 54%.

Engine instruments went right to the green, tail-pipe temperature holding between 360-400 deg. limitation. Rotor brake, located above and between pilots, negated any reading on free turbine tachometer.

Once main rotor is started, a B. F. Goodrich Co. brake holds the free turbine still at low power of engine. When the pilot is ready to apply power, brake is released. Brake, rigidly attached to main gear box, eliminates the clutch—an advantage of the free wheel turbine. Emergency stop, with rotor brake, can halt rotor head in 20 sec.

Prior to takeoff the S-62 had undergone 24 hr. of ground testing and had 24:35 hr. of air time. Engine time was but 22:55 hr. Flight was held to 1,500 ft. maximum. Weather at takeoff was 4,000 ft. broken, visibility 7 mi. Wind was from the southeast at 10 kt. Outside air temperature was 25C. Sea level pressure was 30.06 in.

There was a marked lack of vibration and noise as the aircraft moved forward and, without using the intercom, we could talk to each other without shouting. Helicopter was quite light on the controls and quickly responsive. Hovering at low altitudes, gas generator rpm. was 90%, rotor rpm. 93%. The S-62 is capable of hovering out of ground effect at 8,000 ft. at full gross weight.



PERFORMANCE comparisons of turbine-powered S-62, versus piston-driven S-55.

About 450 lb. of thrust counteracts torque during hovering. Torque meter will be installed in later models. Tail rotor, when applying rudder, takes 55 to 23 hp. Sikorsky has not yet run its performance checks but the S-62, if comparable with the S-55 in these respects, could move sideways at 35 kt., similarly rearward.

Landing Gear

Gear was retracted hydraulically. Retraction is accomplished by cylinders integral with the landing gear struts, designed to lift the wheels vertically to a position slightly above the "on ground" static position. No locks are used, utility pressure (system is a subsystem of the utility systems)—being applied continuously to retracting areas to maintain the wheels in up position.

Inadvertent retraction of the wheels on the ground will squat the aircraft about an inch so no safeguard against ground retraction is provided. Should pressure fail while airborne, gear will automatically drop and lock down. With gear up, wheels protrude from sponsons. The S-62 can land wheels up, but there would be no oleo to take shock.

Helicopter Climb

Helicopter climbed out quickly, ascending at 1,400 fpm., indicating 60 kt. Free turbine and rotor rpm. was 93% in climb; gas generator rpm. was 93.6%. Sikorsky has yet to determine clearance over 50 ft. obstacle, but we gained altitude fast, starting with full power (100% rotor rpm.—flat pitch). Neither has the company completed its height-velocity diagram

S-62 Specifications

	LAND VERSION	WATER VERSION
Fuselage length	44′ 7″	44′ 7″
Fuselage width	5′ 10″	5′ 10″
Height over-all	13′	14′ 2″
Main rotor diameter	53′	53′
Tail rotor diameter	8′ 9″	8′ 9″
Main landing gear tread	10′ 2″	11′
Passenger cabin length	14′	14′
Passenger cabin width	5′ 4″	5′ 4″

S-62 Performance Comparisons

	T58-GE-6	T53-L-1	T58-GE-6	T53-L-1
	LAND VERSION		WATER VERSION	
Gross weight (lb.)	7,500	7,500	7,500	7,500
Basic weight* (lb.)	4,285	4,665	4,550	4,930
Useful load (lb.)	3,215	2,835	2,950	2,570
Cruising speed, sea level (mph.)	98	98	98	98
Maximum speed, sea level (mph.)	119	119	117	117
Hovering ceiling, out of ground effect max. pwr. (ft.)	8,000	8,000	8,000	8,000
Service ceiling, NRP (ft.)	15,700	14,300	15,700	14,300
Vertical rate of climb, sea level (fpm.)	400	400	400	400
Best rate of climb, sea level (fpm.)	1,160	1,160	1,160	1,160
Fuel consumption at cruising speed (gph.)	63	63	63	63
Range—with 182 gal. fuel plus 10% reserve at cruising speed (st. mi.)	230	230	230	230
Seating—accommodations for a copilot and either 12 troop seats or eight airline type seats				
Engine Ratings:	T58-GE-6	T53-L-1**	T58-GE-6	T53-L-1**
Max. pwr. shp. rpm	1,050/19,500	900/18,588	1,050/19,500	900/18,588
NRP shp. rpm	900/19,500	825/18,588	900/19,500	825/18,588
Engine output at trans. Rating shp.	670	670	670	670

*Basic weight includes trapped liquids; useful load does not.

**Uprated T53-L-1. As an interim engine, the T53-L-1 is available at 825 shp. (max. pwr.) and 770 shp. (NRP).

("Dead Man's Curve"), but should tests approach the same level as the S-55 they would indicate an altitude of 100 ft. at 55 mph.

At 1,000 ft., normal cruise—rotor rpm. 93%, gas generator rpm. 88%—the S-62 indicated 90 kt. Increasing power to maximum—93% rotor rpm. and 93.6% gas generator rpm.—airspeed jumped to 110 kt. Indicator is redlined at 130 kt. S-62 responded readily to light control forces; so much that AVIATION WEEK pilot had to anticipate responses in order to curb overcontrolling. Visibility throughout was excellent.

Autorotation Landings

Autorotations presented no manipulation problems. Over water, engine failure was simulated by cutting engine control from 93% cruise to idle, thus cutting power transmitting to rotor system. Collective pitch was dropped, reducing blade angle.

Here a slight vibration was felt. Split needles showed free turbine rpm. to be 70%, rotor rpm. 94%. Gas generator rpm. was 60%. Rate of descent was 1,400 fpm. The water, with 2 ft. deep troughs, seemed to come up in a hurry. Collective pitch was pulled for flareout, checking our rate of descent, and the helicopter cushioned into the water.

The first time in, the S-62 settled in a trough and we felt the wave, a good burst, but rode through nicely. The second time down the helicopter landed on top, like a feather. Water taxiing at turbine rotor rpm. of 96% and gas generator rpm. of 82%, the helicopter rode solidly, without digging or rolling, through varied 360 deg. turns. Hull rode cleanly, the only noise being the slapping of sponsons against the swells as we circled about.

No inflation system is required to provide buoyancy for the S-62. The lower fuselage structure is made watertight by use of bonded joints. By combining flotation with the basic structure, considerable weight savings are realized.

The main hull incorporates five compartments. At gross weight, with any one out or two out forward, the helicopter will still float. The two stabilizing sponsons are divided into three watertight compartments. Only one compartment is necessary to hold stability.

In addition to the main door, located just aft of the right sponson, the S-62 escape exits include pilot's and copilot's side windows, which fall out, a rear window on the right side of the cabin, and two windows on the left side of the cabin.

Before landing, blade stall was accomplished at 1,000 ft. This wasn't easy, as we were flying below gross, and within given speed regimes and weight limitations there is nothing to counteract.

Straight ahead, with rotor speed 83% and helicopter indicating 90 kt., we couldn't stall. We did by putting the S-62 in a level turn to increase centrifugal force and weight. There was some vibration. Recovery—reducing collective

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FROM THE DESERT TO THE ARCTIC..

U.S. ARMY AVIATION BOARD TESTS THE IROQUOIS' METTLE

First helicopter ever developed to meet specific Army requirements for front-line duty, the Bell HU-1A is now taking a series of rigid Army "final exams" before going into action in the field. One of them is the Army Aviation Board's service testing, which will evaluate the combination of equipment and military personnel in their normal operational environment.

Designated the Iroquois by the Army, this all-new, turbine-powered helicopter will be tested by the Board under simulated battle conditions to allow the factors of weather and terrain full play. At a special site near Yuma, Arizona, the Iroquois will go through its "baptism of fire" in the desert heat. One of the most important checks here, and later at Ft. Rucker, will be made on the HU-1A's tactical capability for troop transport, medical evacuation and emergency resupply. In the climatic hangar at Eglin Air Force Base, the Iroquois will go into the deep freeze of −65°F. Then it will be off to Alaska for actual Arctic testing.

Conclusion of the complete Army shakedown will make the Iroquois one of the most thoroughly tested helicopters in the world . . superbly capable of front-line duty . . ready to keep Army Aviation "Above the Best." Bell is proud of its role as partner in military aviation progress . . of its ability to supply the finest equipment for the military.

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to one-stage high speed herringbone reduction; which company says its quieter than standard spur gears. Free wheel unit enables Sikorsky to automatically disengage turbine from engine in event of engine failure, and make an autorotative landing. Upper part of main gear box is an S-55 off-shelf item.

Helicopter, which can haul 2,000 lb. of equipment, is geared to operate from land, water, snow, ice, tundra and swamps. Design lends itself to wide range of utilization: emergency rescue, towing and minesweeping, weapon carrying, aerial surveying, fire fighting, transport and supply, and general utility (AW June 2, p. 74).

Price will run about $215,000-$220,000, depending on whether the customer wants the General Electric T58 or the lower powered Lycoming T53. Installation of the former adds 377 lb. to the aircraft's useful load. Land version of the S-62, minus boat hull and sponsons, is fitted with conventional three-wheel fixed landing gear. Land version is lower, slightly faster, and carries 300 lb. more payload.

Second prototype S-62, now being used for instrumentation flights, may be borrowed by Army or Navy for evaluation, in which case the third model—out by the end of this year—will be used for test work.

Program calls for complete certification of the aircraft before the end of 1959. By the third or fourth quarter of 1960 engines will be available. Noncertificated military aircraft can be delivered in 10 months following order.

Operating Costs

Operating costs for the S-62 are expected to be down at least 30% from those of the piston-engine S-55. Optimum operating cost for the latter, assuming regular scheduled carrier operation of 2,000 hr. per year, is $76 per hr.—$1.52 per ton mile.

Chief savings in military purchase of the S-62 A or B, Sikorsky emphasizes, would be the need for only a few hundred new items rather than several thousand. Biggest immediate savings would be the skipping of purchase of spare components, necessary to new aircraft, in quantities to meet 250 hr. overhaul intervals. The S-62 would embrace 650-700 hr. overhaul components, with service life of rotating components in 5,000-6,000 hr. range, AVIATION WEEK was told.

Existing components of the S-55, used in the S-62, include: main rotor blades, tail rotor blades, main rotor head, tail rotor head, main gear box with new power input section, intermediate gear box, tail gear box, shafting, flight controls (major portion) including servos and S-58 mixing unit, major portion of hydraulic system and tail rotor pylon.

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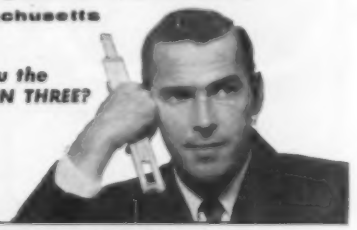

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pitch and increasing rotor speed—was quick.

Landing, at an approach speed of 60 kt. and descent of 1,500 fpm., was preceded by a legalized buzzing of the field at 125 kt. Engine was shut off after first throttling back to ground idle for a cooling down and check.

All-weather operation of the S-62 may be accomplished by adding automatic stabilization equipment developed by Sikorsky for the S-58. Automatic stabilization equipment operates control system without moving pilot's levers, maintaining course, speed and altitude. To accommodate automatic stabilization, an additional servo system would be installed in fore and aft control.

S-62 contains dual cyclic, collective and directional control systems. Primary hydraulic servos are installed on the main gear box for the main rotor control. Auxiliary lateral servo is installed on the aft face of the pilot's seat bulkhead. Primary servos are supplied by pump mounted on the main gear box. Auxiliary lateral servo is supported by the utility system pump.

Both hydraulic systems are interconnected electrically so that, should the operating pressure in either system drop below the normal operating pressure, the other system cannot be switched off. If the helicopter is operating with one system off and a failure should occur in the "on" system, the "off" system will automatically come on. There is no auxiliary servo on the fore and aft and collective pitch control system.

Primary servo system consists of three S-55 primary servos installed at the stationary star. Hydraulic power is obtained by a variable delivery pump driven by the main rotor transmission.

Operating pressure for this system is 1,000 psi. with a relief valve setting of 1,200 psi. Hydraulic power for the auxiliary system is obtained by a separate variable delivery pump also driven by main rotor gear box. Operating pressure for this unit is 1,500 psi. with a relief valve setting of 1,730 psi.

S-62 control dimensions are as follows:

• **Main Rotor**—Disk area, 2,206 sq. ft.; blade area (each), 32.5 sq. ft.; solidity, .04419; airfoil, .0012.

• **Tail rotor**—Disk area, 60 sq. ft.; blade area (each), 3.08 sq. ft.; solidity, .1025; airfoil, .00165 to .0012.

• **Stabilizer**—Area, 8 sq. ft.; span, 68 in.; chord, 17 in.; aspect ratio, 4; airfoil, .0015; angular movement, plus or minus 15 deg.

Sikorsky built its own gearbox for the S-62, at a saving of 60-70 lb. of weight. Main gearbox also is used as rear support for engine. Ratio is 93:1; 20,000 rpm. for free turbine and 211 rpm. for main rotor. The 20,000 free turbine rpm. (max.) comes in to main gearbox

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THE LOS ANGELES DIVISION OF
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wingspan, 33 ft. 4 in.; length, 21 ft.; height, 6 ft. 11 in.; wing area, 160 sq. ft. Wing loading is 9.4 lb./sq. ft. and power loading is calculated at 15 lb./hp. Manually operated wing flaps have an area of 17.24 sq. ft.

The Continental O200-A turns out its 100 hp. at 2,750 rpm. Recommended overhaul time has been set initially as 600 hr. Its basic dry weight is 189.6 lb.; 220 lb. including accessories. Displacement is 200.91 cu. in. with a 7:1 compression ratio. Fuel requirement is 80/87 octane.

Landing gear is same chrome vanadium steel spring type used on previous Cessnas. Tread between main gears is 77 in. and is designed to provide good ground handling characteristics in windy weather. Gear is fitted with new Goodyear gear-toothed brakes having matched gears and teeth around the perimeter of the wheel disks and inside the wheel castings, replacing keys and clips previously used to hold the disks in place. Plane is furnished with nylon tubeless tires, all 5.00 x 5.

Top and bottom of the seat is adjustable forward and back; top of the seat folds forward to provide access to 80-lb.-capacity baggage compartment. Above the baggage compartment is a utility shelf, which can be replaced by a children's seat, capable of holding two, which will be available in kit form from the factory as optional.

Cessna Readies 210 For Late 1959 Sale

New single-engine Model 210 business plane "of advanced design" is being flight tested by Cessna Aircraft Co. and will be available to purchasers in late 1959.

Configuration and performance details are being kept a tight secret. Commercial Aircraft Division Vice President-General Manager Dale Roskam will only state that the Model 210 will give the company an entry in the high-performance single-engine market between the Skylane (top speed 168 mph.) and the 310 (232 mph.).

MODEL shows configuration of two-seat turbine helicopter Doman is designing. Maximum speed would be 160 mph.

Doman Designs Turbine Helicopter

Danbury, Conn.—Preliminary engineering has been completed by Doman Helicopters, Inc., here, on a new two-place turbine-powered helicopter designed for a top speed of 160 mph. Company estimates that in production quantities, its new Model D-12 will sell for approximately $12,000.

Project is based on a design study made by Doman for the Army. Powerplant planned for the D-12 is the new 250-hp. Allison 250-C1 turbine, which was winner of a recent Army competition (AW July 21, p. 26). Engine weighs under 100 lb. Fuel consumption is approximately .7. With this engine, the proposed D-12 would cruise at 140 mph. and have a rate of climb of 2,400 fpm., Doman reports. Vertical rate of climb is estimated at 1,900 fpm., hovering ceiling in ground effect as 23,000 ft., hovering ceiling out of ground effect as 18,000 ft. and service ceiling as 29,000 ft. Range is calculated as 300 mi. and endurance at 2.5 hr.

Doman D-12 is designed for a gross weight of 1,450 lb. Over-all length is 26.3 ft., total height 7.7 ft., fuselage width 4.8 ft. and landing gear tread 7.5 ft.

Main rotor would have a maximum diameter of 22.5 ft., can be varied according to the helicopter's application. Pilotless version would require a smaller rotor, Doman states. Tail rotor diameter is calculated at 3.3 ft.

Design is planned for quick teardown and maximum accessibility, the company reports, with all components of transmission, powerplant and rotor system arranged so that they can be serviced or replaced without disturbing other elements.

TRAINING, charter, pleasure and business flying are fields for which new two-seat Model 150 has been designed.

Cessna Re-Enters Two-Seater Market

Wichita, Kan.—Introduction of new side-by-side two-place all-metal Model 150, in October, will provide Cessna Aircraft Co. with the broadest product representation in the business flying industry, comprising a total of seven distinct types.

Model 150 is the first two-place airplane built by the Wichita, Kan., company since the Model 140 was discontinued in 1950 and a subsequent upsurge in business flying resulted in heavy emphasis on four-place private airplanes. New airplane is an attempt to supply a growing demand for a modern all-metal two-seater.

Company reports that it already has firm orders on its books for 600 Model 150s from its distributor organization, in addition to another 115 being allocated for export; this total consumes the entire number of airplanes it had committed for its initial production run.

Cessna expects high sales volume and long production life for its new airplane. To broaden its sales potential, the Model 150 will be available in three versions:

• **Standard,** priced at $6,995, which includes as standard equipment a metal fixed-pitch Sensenich propeller, starter, 20-amp. generator, recording tachometer, standard altimeter, navigation lights, single-unit oil pressure, oil temperature and electric fuel gages, carburetor heater, stall warning indicator, airspeed indicator, parking brake, hydraulic toe-operated brakes (on pilot's side only) and steerable nosewheel.

• **Trainer,** priced at $7,940, having a Narco Superhomer with nine crystals (Sunair on export models), microphone and cabin speaker, turn-and-bank indicator, rate of climb, outside air temperature gages, dual controls, landing lights, sensitive altimeter, clock, sun visors, control lock and cigarette lighter.

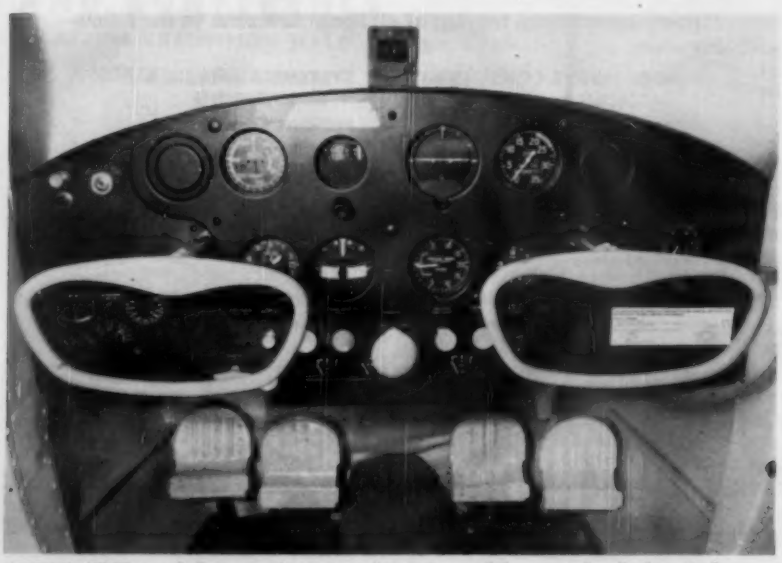
• **Inter-city commuter,** at $8,545, includes direction and horizon gyros with engine-driven vacuum system and fin-mounted rotating beacon. This model also has all of the trainer's standard equipment except the dual controls.

Available in the future will be a special "patrol" wing with additional fuel capacity for pipe line patrol or other specialized long-range missions.

Model 150 is powered by a new 100-hp. Continental O200-A engine, providing a top speed of 124 mph. at sea level and maximum recommended cruise speed of 121 mph. at 70% power at 9,000 ft. Range at maximum cruise is 520 mi. or 4.3 hr. At economy cruise, using 43% power at 10,000 ft., the Model 150 will have a range of 630 mi. or 6.6 hr. at true airspeed of 95 mph.

Fuel capacity is 26 gal., with 22.5 gal. comprising the alloted usable fuel.

Plane is designed for a 740-fpm. rate of climb and service ceiling of 15,300 ft. Gross weight is 1,500 lb.; empty weight is 962 lb. Dimensions include:



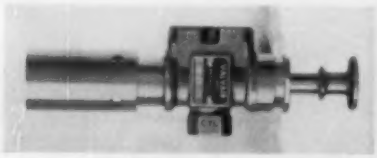
INSTRUMENT panel shows equipment on inter-city model, except for dual controls.

and 300 psig. Flow rates under these conditions are 8 to 20 scfm. of air or nitrogen. Regulator weighs 1.5 lb.

Wallace O. Leonard, Inc., 373 S. Fair Oaks Ave., Pasadena, Calif.

Emergency Hydraulic Valve

Reverse acting, panel mounted manual valve for up to 200 psi. pneumatic, hydraulic or vacuum service is designed for emergency control applications, where fast push-type action is desired.



Reverse action is imparted by a standard spring return end section, mounted on a two, three or four-way manual valve body in sizes from ¼ through ¾ NPT. Valves are designed to fit standard thickness control panels.

Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

Jet Aircraft Tire

Aircraft tire with dimpled tread design is said to outperform and outwear other jet tires. Photo shows 30-8.8 tire mounted on Convair F-106.

Fabric tread tire will be standard on the F-106, the tire company states.

B. F. Goodrich Co., Akron, Ohio.

Oil Cooler Cleaner

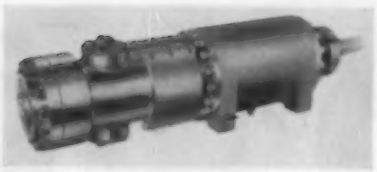
System for cleaning aircraft oil coolers is faster, less expensive and easier than present methods, the maker states. Special agent used is said to eliminate possibility of corrosion.

Oil cooler is put on tracks of a stainless steel cabinet and hoses are attached to run solvent through the unit. Cleaning agent is then run through the cooler and cooler is then flushed with trichlorethylene.

Cee-Bee Chemical Co., Inc., 9520 E. Cee-Bee Dr., Downey, Calif.

High Pressure Cryogenic Pump

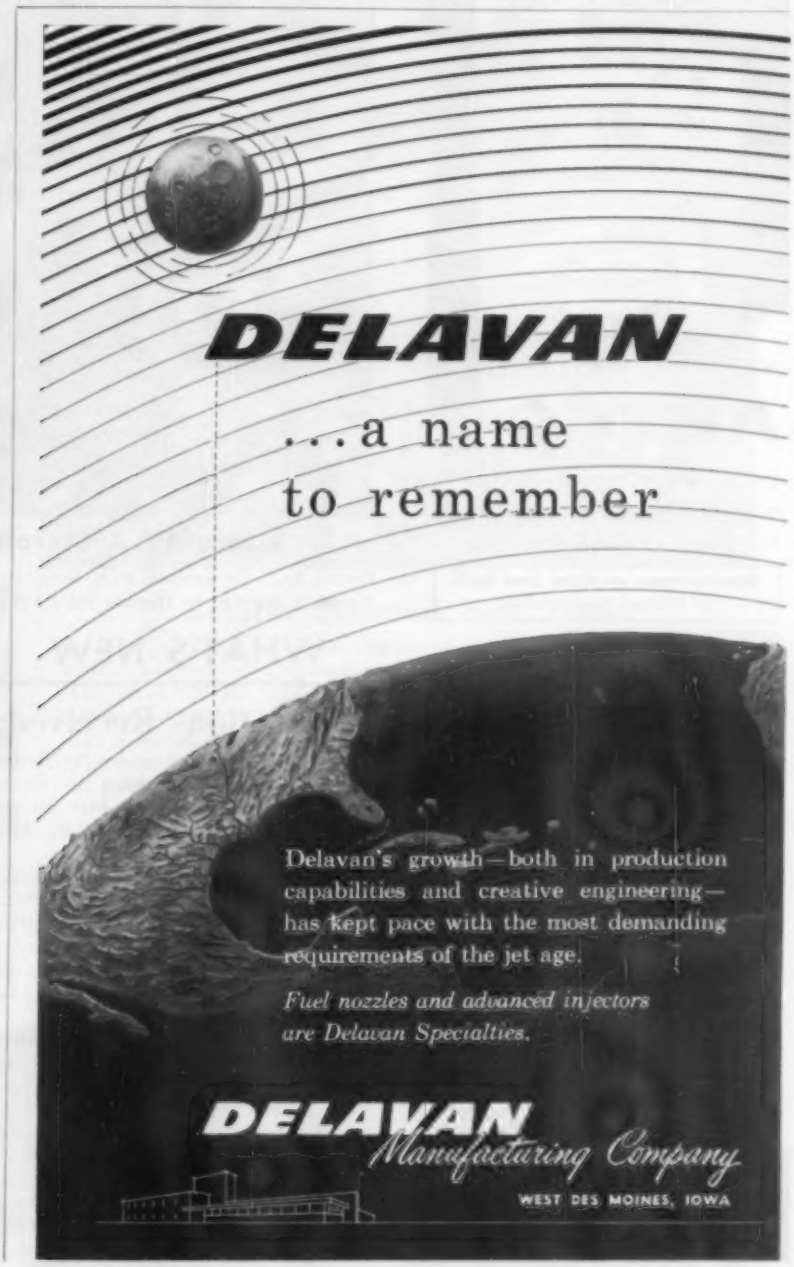
Stainless steel liquefied gas pump, currently being installed at Edwards AFB, produces pressures to 10,000 psi with flows to 10 gpm., the manufacturer says. It is suited for trailer-mounted oxygen or nitrogen rechargers,



booster stations or cascade systems.

Pump, a five cylinder reciprocating action type, is 36 in. long and weighs 400 lb. in its portable configuration. Handling liquid oxygen, nitrogen or argon, pump is said to have industrial as well as military applications.

Dynamic Research, Inc., subsidiary of Air Products, Inc., Allentown, Pa.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DELAVAN Manufacturing Company
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NEW AVIATION PRODUCTS

Polaroid Aerial Camera

Polaroid spotting camera, developed for aerial reconnaissance photography, is said to have application where instant photographs are needed.

Model 110 has a 10 in. focal length, f/5.6 Raptar telephoto lens and uses eight-exposure Polaroid roll film. Camera develops 3 in. x 4 in. opaque positives in 60 sec., the maker states. Shutter speeds are 1/125, 1/250 and 1/1,500 sec. Aluminum camera, weighing 8 lb., is designed to be held in the hand.

Mast Development Co., Inc., 2212 E. 12th St., Davenport, Iowa.

Self-Cleaning Fuel Strainers

Fuel strainer uses diatomaceous earth as a means of filtering contaminants out of aviation turbine fuels. Jet strainer is used in the petroleum industry for filtering solids out of water and petroleum products.

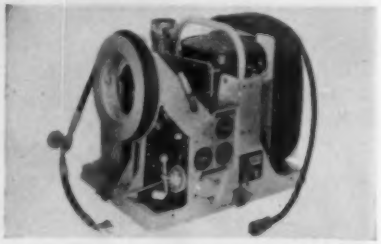
Diatomaceous earth is added to jet fuel to be filtered. Powder forms an open, porous cake which is fine enough to trap contaminants but porous enough to let the filtered fuel pass through it. Strainer cleans itself through a system of revolving jets which scour the screen and flush out solids.

Thornhill-Craver Co., P.O. Box 1184, Houston, Tex.

Ground Support Compressor

Portable air compressor for ground support of aircraft and missile systems is said to meet all pneumatic needs except that of fuel air starter systems.

Compressor is available in both electric and gasoline engine powered models. Model 130R3500 (shown) is the electric unit which operates on 200



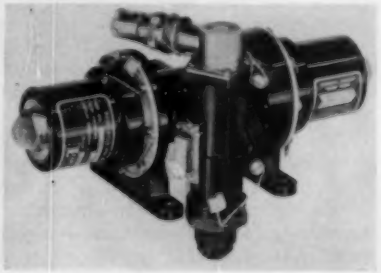
volt, 400 cycle, 3 phase current. This model delivers 2 cfm. air from 50 to 3,000 psi. Weight is 92 lb. Model 130R1409, weighing 130 lb., is operated by a 2½ hp. single cylinder 4 cycle gasoline engine. Gasoline powered compressor delivers 2 to 4 cfm. of air at 50 to 3,000 psi.

The Cornelius Co., 550 39th Ave. N.E., Minneapolis 21, Minn.

Missile Pneumatic Regulator

Two-stage pneumatic regulator is designed for pressurization of instrument air bearings on missiles. Multi-poppet design is said to provide close regulation of outlet pressures over a wide range of inlet pressures.

Regulator is said to maintain an adjustable outlet pressure of between 50 and 30 psig. within + or − .2 psi. at inlet pressures varying between 3,000



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Some Exceptionally Good Opportunities for **CONTROLS ENGINEERS** at General Electric's Jet Engine Department

Because our product responsibility now includes Controls Design and Test Instrumentation Design, staff positions are open now for the following men:

Electronic Systems Engineers. Responsible for electronic design portion of the data system; develop new and improved electronic methods of accomplishing the system's requirements; investigate present and future instrumentation systems to determine data deficiencies.

Controls Component Mech. Design Engineers. Conduct the design, development, evaluation and modification of mechanical control components for assigned engine projects.

Servo Analysis Engineers. Responsible for initiation and execution of programs to formulate servo systems design; determine and define stability requirements for engines and controls; analysis and design of applied servo-mechanisms for all jet engines.

Control Systems Evaluation Engineers. Responsible for initiating, planning and accomplishing bench evaluation programs on engine control and accessory systems, and for designing, procuring, and evaluating assigned sub-systems of slave engine controls.

Control Systems Reliability Engineers. Determine the reliability of engine controls systems by mathematical analysis and design review; provide for design changes; establish overhaul and replacement criteria; develop reliability requirements for components of advanced systems. Emphasis on mechanical and hydraulic components.

These are "career" positions with starting salary levels of $7,000 to $10,000. Positions of greater responsibility also available. If you qualify, we will invite you to vist us at our expense to talk with our engineering managers and see how we work.

For additional information, write
Mark Elwood, Jet Engine Dept. AW-825
General Electric Co., Cincinnati 15, Ohio

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JET ENGINE DEPT. CINCINNATI 15, OHIO

measurements, junction transistors, theory and preparation of p-n junctions and point contact transistors. Manufacture and special transistor types are covered illustrating pertinent design problems; also new transistor materials, transistor physics and performance of available devices and impurities.

Automation Systems—Sponsored by Engineering Department—Pub. Engineering Publishers, Division of the AC Book Co., Inc., New York. $5.00; 180 pp.

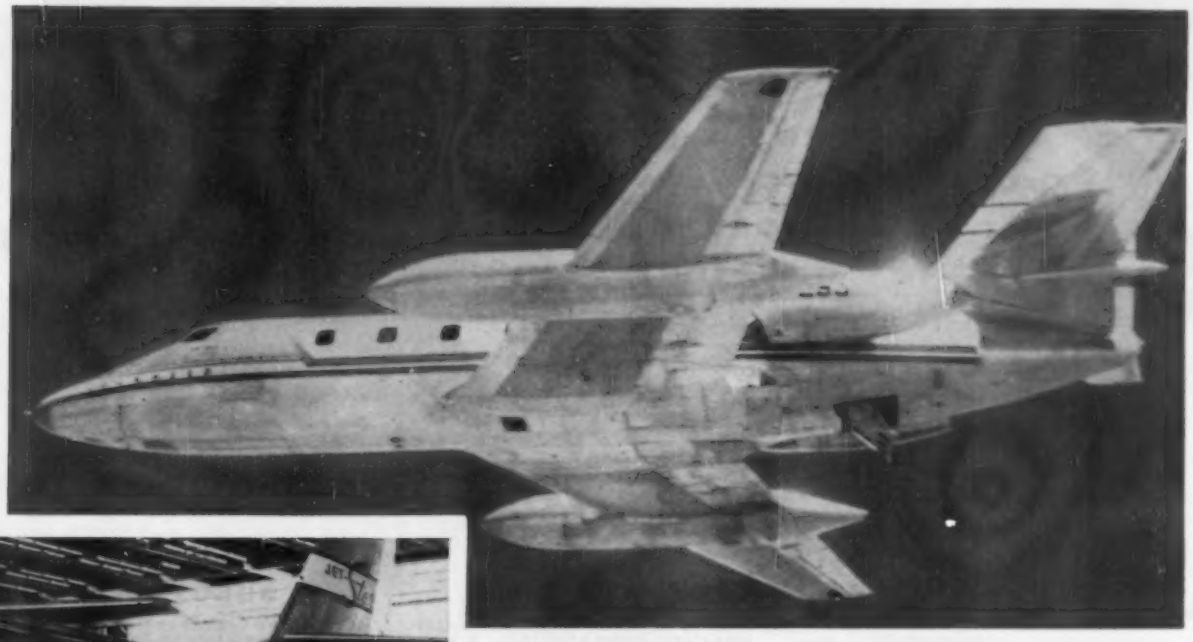
This book contains the proceedings of the second Electronics Industries Assn. on Automation Systems for 1958. For engineers and executives who have an interest in automation.

Civil Air Regulations & Flight Standards for Pilots—published by Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif. $2.25.

The 19th edition of this pilot's manual for 1958 contains government requirements, air-laws and flying procedures applicable to all pilots. Included are flight rules, radio-telephone use, airport traffic control, requirements for various pilot certificates, search and rescue services, air defense requirements, how to read weather reports and also a study guide and sample written examination for the private pilot license.

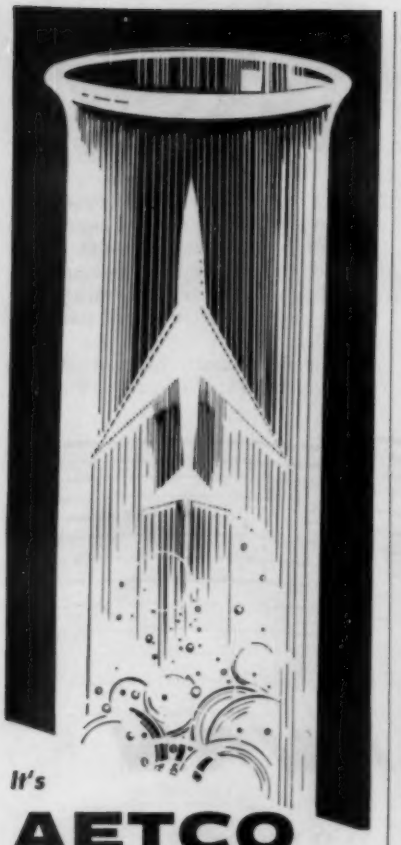
Airplane Design Manual—by Frederick K. Teichmann, published by Pitman Publishing Corp., 2 West 45th Street, New York 36, N. Y. $8.50, 489 pp.

First published in 1939, this fourth



JetStar External Fuel Tanks

Lockheed JetStar has been fitted with intermediate and long range fuel tanks in midwing position, increasing aircraft's range to more than 3,000 mi. Inset photo (left) shows 300 gal. capacity slipper tank. Flight and front view (top and bottom) shows JetStar fitted with 640 gal. glove tanks. For glove tank installation,* wing is washed out at inboard position (below) to reduce interference effects. Flight photo shows glove tank length; note extended speed brake. Lockheed says JetStar has flown 3,105 mi. nonstop using the glove tanks. Company tested the tanks on recent around-the-nation flight. With slipper tanks fitted, JetStar flew 1,900 mi. in 3 hr., 23 min., at 41,000 ft.



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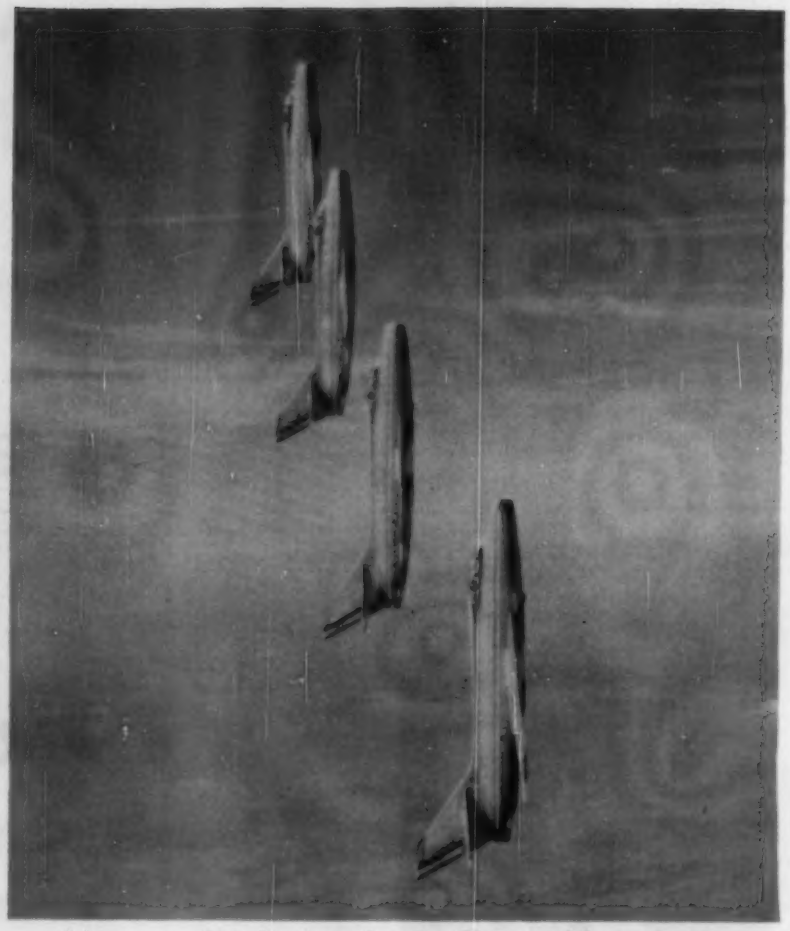


Mystere IV-A Acrobatic Team Maneuvers

French Air Force acrobatic team demonstrates climb capability of Dassault Mystere IV-A. Aircraft is powered by Hispano Suiza Verdon turbojet engine, producing 7,700 lb. thrust.

WHAT'S NEW

Publications Received:

Impedance Matching – by A. Shure, Ph.D., Ed. D.–Pub. John F. Rider Publisher, Inc., 116 West 14th Street, New York 11, New York. $2.90; 119 pp.

This electronic technology series deals with the problems of impedance matching at audio, radio, and higher frequencies. It also explains the theory underlying problems and solutions of impedance matching.

Inspection For Disarmament–Edited by Seymour Melman–Pub. Columbia University Press, 2960 Broadway, New York 27, N. Y. $6.00; 291 pp.

This book deals with a major point of designing systems of inspection to ensure compliance with any disarmament program or agreement which might be made with international countries.

The Helicopter–by Jacob Shapiro–Pub. The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. $4.50; 269 pp.

This book gives the framework of the helicopter without specialized technical jargon.

Aircraft and Missile Propulsion-Volume No. 1–by M. J. Zucrow–Pub. John Whiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York. $11.50; 538 pp.

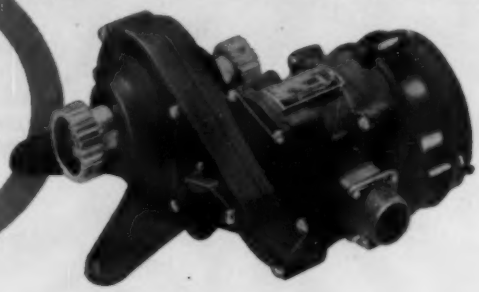
The beginning of a series of books dealing with thermodynamics of fluid flow and its application to propulsion engines. This volume is the beginning of a three volume work which is designed to aid the student and engineer.

Fundamental Principles of Transistors –by J. Evans, B.Sc., Ph.D., A.K.C., Standard Telecommunications Laboratories, Enfield (G.B.); published by D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, N. J. $6.75, 267 pp.

Simple account of the theory of semiconductors precedes explicit material on

Emergency flap drive on Boeing 707 Stratoliner is provided by Airborne Model R1624-1 special-design rotary actuators. Units are permanently coupled to flap linkage, provide electro mechanical drive in event of hydraulic failure. Output shafts are driven whenever hydraulic system operates, but because of special inertial clutch, rotors do not turn unless energized.

AIRBORNE LARGE SPECIAL ACTUATOR SOLVES EMERGENCY FLAP DRIVE REQUIREMENTS ON BOEING 707



Specifications: Motor: 200/115 v a-c, 400 cycles, 3-phase, reversible. Speed at rated torque (450 in-lb): 85 rpm ± 10 rpm. Duty cycle 3 min. on, 27 min. off. Operating range: 102-124 v (line to neutral); 380-420 cps; −65 to +160°F; 0-50,000 ft. Weight 12 lbs.

In addition to offering an extensive line of modular-type electromechanical actuators, Airborne can also meet your requirements for large special designs—linear or rotary. Typical of these special Airborne actuators is Model R1624-1, used on Boeing's new 707 Stratoliner to operate the flaps in the event hydraulic power is lost. At the right are some of the more difficult engineering problems that were presented by this specialized application, along with Airborne's solutions to them.

PROBLEM	SOLUTION
Rotor to be disconnected from output gear stages except when motor is energized in either direction.	Inertial clutch—consisting of small weights in a cage—incorporated between motor and gear train. Makes positive contact with intermediate drive gear only when rotor shaft turns.
Starting torque to be 800 in-lb minimum, with pullout torque of 900 in-lb (±100 in-lb) at 50% motor slip (±10%) under all voltage, frequency and environmental conditions.	Special lightweight motor developed by Airborne to meet these exacting requirements. Rated .9 hp at 10,300 rpm, drawing 2.5 amp maximum.
In event of a jam in actuator transmission or rotor, unit to be fail-safe by permitting rotation of output shaft by torque of 1000-1300 in-lb. Once started, rotation to be maintained by torque not exceeding 100 in-lb.	Special ball-detent, torque-limiting clutch incorporated on output shaft.

Contact us for recommendations on your special actuator requirements . . . or for information on Airborne's standard line of modular design actuators.

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edition has been expanded to encompass recent developments in the field of airplane design. In addition, an attempt has been made in this revision to amplify the analytical approach to design problems as well as the purely empirical approach.

Gas Dynamics—by Ali Bulent Cambel and Burgess H. Jennings, published by the McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $11.00, 415pp.

Here in one volume are numerous topics usually explained in several by different specialists. The book covers phenomena of particular concern to the propulsion engineer and includes material pertinent to preliminary design and to testing as well as research in almost all areas of high-speed flow. Materials of diverse nature such as analytical definitions and experimental techniques are brought together.

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Corrosion Preventive Additives—by Armour Research Foundation, for Wright Air Development Center, U. S. Air Force. $3.00; 120pp. (PB 131459).

Development of a Universal Method for Grease Analysis—by M. T. Fisher, Rock Island Arsenal Laboratory, U. S. Army Ordnance Corps $.50; 16pp. (PB 131354).

Lubrication of Titanium—by R. O. Lee and N. Fatica, Clevite Research Center, for Wright Air Development Center, U. S. Air Force. $1.50; 51pp. (PB 131650).

Final Report on Studies of Turbulent Premixed Flames and Methods of Suppressing Combustion Oscillations—by A. A. Putnam, G. M. Clough, and M. J. Kenworthy, Battelle Memorial Institute, for Wright Air Development Center, U. S. Air Force. $3.50; 132pp. (PB 131430).

Coordination Polymers, Part 2—by W. C. Fernelius, and others. The Pennsylvania State University, for Wright Air Development Center, U. S. Air Force. $2.00; 71pp. (PB 131649)

The High-Temperature Kinetics of the Hydrogen-Bromine Reaction—by A. Levy, Battelle Memorial Institute, for Wright Air Development Center, U. S. Air Force. $.75; 26pp. (PB 131618).

Generalized Equations and Procedures for the Calculation of Detonation Parameters: Case 1—Ideal Gaseous Mixtures—by R. G. Dunn and B. T. Wolfson, Wright Air Development Center, U. S. Air Force. $3.00; 95pp. (PB 131233).

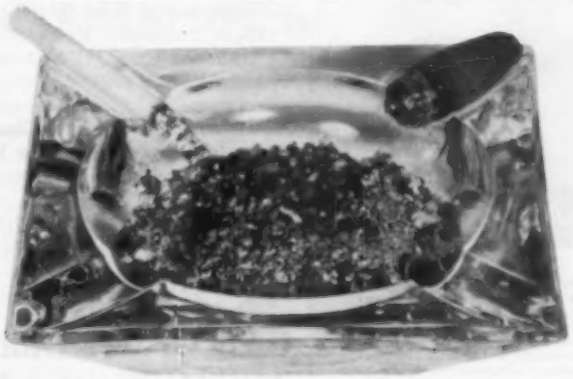
The Design and Construction of a Special Test Fixture for the Static Evaluation of the Corrosive Effects of Boron Exide at High Temperatures—by C. R. Andrews, University of Dayton Research Center, for Wright Air Development Center, U. S. Air Force. $1.50; 51pp. (PB 131667).

Development of Fluoro-Silicone Elastomer, Part 3—by G. W. Dyckes, Peninsular Chemresearch, Inc., for Wright Air Development Center, U. S. Air Force. $1.75; 63pp. (PB 131425).

Development of Thermally Stable Silicon Containing Resins, Part 2—by L. W. Breed, F. Baiocchi, and C. C. Bolze, Midwest Research Institute for Wright Air Development Center, U. S. Air Force. $2.00; 76pp. (PB 131715).

Direction-of-Knob-Turn Stereotype—by J. V. Bradley, Wright Air Development Center, U. S. Air Force. July, 1957. $.50; 15pp.; (PB 131612).

Basic Factors in the Formation and Stability of Non-Soap Lubricating



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Research Products waterless, electric-incinerating toilet — the INCINOLET — works as a complete disposal plant, reducing all human waste to odorless, inorganic ASH ... bacteria free.

Capable of offering sanitary facilities at any spot on the map, INCINOLET can be used on aircraft, at ground installations (line facilities, guardhouses, barracks and BOQ's), on mobile facilities, and at remote areas.

INCINOLET, with corrosion-free heater operation and complete odor control, represents many years of research by the scientist who designed the first electric-incinerating toilets to operate successfully on United States Air Force aircraft.

Aircraft model INCINOLET less than 20 pounds.

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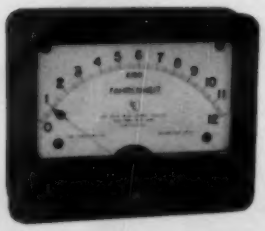
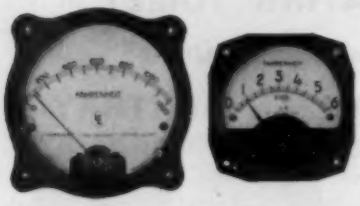
Indicating Pyrometers

for temperature testing in the laboratory or in the plane...

Constructed with the same care as our aircraft temperature indicators, these pyrometers bring "aircraft quality" to the test engineer.



MODEL 58PY, above, has been used extensively by leading motor car manufacturers for road testing on the "Proving Grounds" — where performance counts. Housed in rectangular bakelite case, has 6" hand drawn scale and is fully compensated for ambient temperature. Made in ranges listed below, with suitable thermocouple materials.



MODEL 23B, left above, has same type movement as our aircraft pyrometers. Housed in flanged, 4" round, bakelite case for panel mounting.

MODEL 20B, right above, has same 3" steel case and same movement as our aircraft panel indicators. Both are fully cold-end compensated and available in standard ranges listed, with suitable thermocouple materials.

STANDARD RANGES—All Models
FAHRENHEIT
Zero to 400, 600, 800, 1000, 1200, 1600, 1800, 2000 and 2500.
CENTIGRADE
Zero to 200, 300, 400, 500, 600, 800, 1000, 1100 and 1400.

Furnished with white scales, black markings and pointer or, with black scales white markings and pointer if specified. For best results use LEWIS Thermocouples, Leads and Selector Switches with these instruments.

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Manufacturers of Complete Temperature Measuring Systems for Aircraft
NAUGATUCK, CONNECTICUT

Greases: Part 3—by J. J. Chessick and A. C. Zettlemoyer, Lehigh University for Wright Air Development Center, U. S. Air Force. June, 1957. $1.50; 52pp.; (PB 131233).

Theroretical and Experimental Studies of Liquid Viscosity—by F. C. Collins, Polytechnic Institute of Brooklyn, for Wright Air Development Center, U. S. Air Force. July, 1957. $1.00; 36pp.; (PB 131403).

High Temperature Wear Evaluation Techniques and Data—by R. J. Benzing, Wright Air Development Center, U. S. Air Force. July, 1957. $.75; 24pp.; (PB 131410).

Bibliography of Fuel Stability, 1929-1957—by Southwest Research Institute for Ordnance Corps, U. S. Army. $5.00; 197pp.; (PB 131482).

Man-Machine Dynamics: Chapter VII of the Joint Services Human Engineering Guide to Equipment Design—by J. H. Ely, H. M. Bowen and J. Orlansky, Dunlap and Associates, Inc., for Wright Air Development Center, U. S. Air Force. November, 1957; $3.00; 119pp; (PB 131576).

CAA Orders Global Time Converter Unit

New York—Global time conversion chart developed by Lt. Col. John G. Daiger, Newark, N. J. has been purchased by Civil Aeronautics Administration for distribution to control centers and range stations.

Daiger chart, called Time Conversion Simplifier, shows corresponding Greenwich Mean Time for any section of the world. Simplifier also lists standard and daylight saving time zones and is calibrated on 24-hr. clock system.

CAA now uses Greenwich Mean Time for all domestic air control purposes. Initial order was for 3,000 charts. Simplifier is produced by Daiger Associates, Chamber of Commerce Bldg., Newark, N. J.

Spark Plug Methods Approved by CAA

Civil Aeronautics Administration has approved production and inspection methods of AC Spark Plug Division and will permit the maker to mark its spark plugs with the symbol "CAA-PMA." PMA stands for "parts manufacture approval."

Spark plug manufacturer, maker of 18 types of plugs, requested the inspection of its facilities after the CAA announced its policy of inspecting parts for reliability and safety.

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A BS or advanced degrees in EE, ME, or Physics, may qualify you for a rewarding career at North American Aviation, in one of these fields:

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Please write to: Mr. A. H. Stevenson, Engineering Personnel, North American Aviation, Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

WHO'S WHERE

(Continued from page 15)

Changes

Martin A. Warskov, consultant to the Department of Aviation Systems Research, Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc., Mineola, N. Y.

Wyman L. Henry, director of marketing Beech Aircraft Corp., Wichita, Kan. Also: **R. H. Owen,** manager, Beech Aircraft's newly formed manufacturing engineering division.

Bell Aircraft Corp.'s Niagara Frontier Division has announced establishment of a West Coast office, Los Angeles, Calif., and the following appointments: **Edwin E. Gorin,** senior West Coast representative and Avionics Division representative; **Frank R. Herud,** Rockets Division representative; **Jerome C. Gregoire,** Space Flight and Missiles Division representative.

Col. Harry D. Copland (USAF, ret.), manager, Aviation Department of the State of Florida.

Dr. Arthur Bramley, technical specialist, Stromberg-Carlson, a division of General Dynamics Corp., San Diego, Calif. Also: **Brig. Gen. William L. Bayer** (USA, ret.), director of planning, Stromberg-Carlson's Electronics Division, Rochester, N. Y.

T. A. Wilson, head-Advanced Project Proposal Team, Systems Management Office, Boeing Airplane Co., Seattle, Wash. **D. E. Graves** and **I. W. Nealon** will assist Mr. Wilson. Also: **Ben F. Werner,** manager-weapon system support management branch, Dyna-Soar program of the Systems Management Office.

Harold Morris, assistant technical director, Donner Scientific Co., Concord, Calif.

William E. Howell, project manager-Air Force Minuteman program, Hercules Powder Co., Wilmington, Dela.

Karl H. Epple, director of engineering, and **Edward W. McLaren,** director of manufacturing, Heli-Coil Corp., Danbury, Conn.

Robert A. Bailey, director of marketing, Industrial Products Division, International Telephone and Telegraph Corp., San Fernando, Calif.

John A. Grimes, general manager, Test Equipment Division, Consolidated Diesel Electric Corp., Stamford, Conn.

Charles L. Davis, general manager, and **W. T. Noll,** assistant general manager, Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Byron F. Deming, manager-Redstone engine program, Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif.

C. C. Pearson, assistant director of manufacturing, Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif. Also: **Leslie D. Myers,** chief manufacturing engineer, Missile Systems Division. **Emil J. Docekal** succeeds Mr. Myers as plant engineer of Lockheed's Georgia Division, Marietta, Ga.

Donald W. Gere, head of security planning, Ramo-Wooldridge Corp., Los Angeles, Calif.

W. A. Benson, project manufacturing manager of the newly formed JetStar Manufacturing Division, Lockheed's Georgia Division, Marietta, Ga.

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THE FRONTIERS OF SPACE

Lockheed Missile Systems Division, recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics," holds such important, long-term projects as: the Navy Polaris IRBM, Earth Satellite, Army Kingfisher target missile, and the Air Force X-7 ramjet test vehicle.

To carry out such complex projects, the frontiers of technology in all areas must be expanded. Responsible positions in our research and development laboratories and in our project organizations are available now for high-level engineers and scientists.

If you are experienced in physics, mathematics, chemistry or one of the engineering sciences, your inquiry is invited. Please write Research and Development Staff, Sunnyvale 2, California. (For the convenience of those living in the East and Midwest, offices are maintained at Suite 745, 405 Lexington Ave., New York 17, and at Suite 300, 840 N. Michigan Ave., Chicago 11.)

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Several things set the Polaris apart from other outer space weapons in the ballistic missile category, for the Polaris program involves a wholly new concept of weaponry:

1. It will be dispatched from beneath the surface of the sea.
2. It will be radically smaller than currently developed land-launched missiles, yet its payload will be as effective and its range the same as other IRBMs.
3. It will be the first operational outer space missile to employ solid fuel as a propellant.
4. It will travel through three mediums in a single flight: water, air, outer space.
5. Its launching base—a submarine—is not fixed but a mobile vehicle.

OUTER SPACE PROGRAM

Very little can be said about the Earth Satellite program at this time except that its success will necessitate advancing the state of the art in all sciences.

The Earth Satellite Project is perhaps the most sophisticated outer space program to reach the "hardware" stage in the U.S. today.

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The Kingfisher is the nation's fastest target missile, developed for the Air Force and currently being manufactured for the Army to test the accuracy of our newest supersonic weapons.

It is a ramjet target vehicle with Mach 2-plus capabilities. The Kingfisher not only has the speed to match the defensive missiles, but can also simulate a vast array of supersonic enemy missiles and airplanes attacking from great height. It is instrumented to score near misses and even theoretical hits without itself being destroyed.

It is recoverable from flight by parachute to be flown again, permitting weapon system evaluation to be conducted at greatly reduced cost.

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PLAN '59

A MESSAGE TO AMERICAN INDUSTRY

Modernize Now — For Growth and Profits

The biggest challenge facing American industry today is that of thoroughly modernizing its plant and equipment. This is the test period for companies to prepare for success — or failure — in the '60s. Success depends decisively on one key policy — modernization, for growth and profits.

Data from *Business' Plans for New Plants and Equipment, 1958-1961*, a survey by McGraw-Hill Dept. of Economics

The problem of business recession is fading. Sales and industrial production are moving up again, slowly. Business is swinging back into its normal course. This is growth, not retreat and recession. If the recovery takes us back to the normal growth trend, industrial production will be up 15% to 20% by 1960.

But how can we get this growth in production without the plague of price inflation that has blighted our economy in recent years? And, of fateful consequence for the individual business firm, how can it keep its costs down enough to make a decent profit — something a very large share of American companies are not doing today?

This is the new challenge that confronts business as the recession is left behind.

Nature of the Challenge

The recent record on costs and productivity is not reassuring. Since 1947 wages in manufacturing have risen 68%, while output per manhour has gone up 32%. This is a dismal record for a nation that has prided itself on

gains in industrial efficiency. Clearly, if we are to avoid continuing inflation, labor must key its wage demands more closely to productivity increases. But clearly, also, we must do far better in raising output per manhour. Otherwise, industry cannot hope to offer stable prices, and still make a profit.

What, then, is the answer? It is modernization of plant and equipment, the replacement of obsolete producing facilities with new and more efficient machinery and buildings. Only in this way can industry hope to increase production, hold down costs and make a good profit showing in the years of growth that lie ahead.

Industry's Answer

The chart on the preceding page shows how American industry is buckling down to the task of modernizing its facilities over the next four years. It is planning to replace old equipment with new machines that will raise output per worker not just 2% or 3% a year, but more like the 5% annual gain in productivity that this nation achieved in the years following World War I.

Since World War II we have had to contend with shortages of capacity and materials that have held back the job of raising productivity. But today the machines and techniques are available. And industry is getting set.

A broad sample of manufacturing companies surveyed by the McGraw-Hill Department of Economics earlier this year reported these plans: **In 1958, expenditures for modernization will rise to 56% of total investment in new facilities — compared to 48% in 1957. And this emphasis will increase until by 1961, expenditures for replacement and modernization account for two-thirds of all capital spending by manufacturing companies.** In dollar terms, manufacturers will spend more on modernization in each of the four years 1958-61 than in any previous year except 1957.

Can It Be Done?

These are big plans. Can they be carried out? Is it too visionary to hope that after a decade of expansion, industry can now find the outlets for huge amounts of capital investment in the area of modernization? The answers are important to business and the nation, because on this new wave of modernization depends our hope of holding down costs and prices, and also the prosperity of the vital capital goods industries — generators of boom and bust in our economy.

To ensure that industry gets the answers, McGraw-Hill's 34 business publications are now starting a coordinated effort — the largest editorial effort in the history of our company — to find, report and publish the opportunities for modernization at a profit, in the fields we serve. These special reports will begin in late September and will run through November, with appropriate coverage for the specific needs of each field. We are proud to share with industry the responsibility for making sure that no opportunity is overlooked in the drive to modernize now for growth and profits.

This message was prepared by the McGraw-Hill Department of Economics as the first step in our company-wide effort to report on opportunities for modernization in industry. The Department is also preparing a longer report, on modernization as a national problem, for publication in October.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all parts of the present text.

Donald C. McGraw
PRESIDENT

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FIELD OF FLIGHT DEVELOPMENT

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Diversified Assignments On Dynamic Applications & Developments Of Tomorrow's Aircraft

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Flight Test Data Analysis

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for Specific Systems

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Flight Test Project Engineers

To plan and coordinate the all-over activities of specific tests is the responsibility of Flight Test Project Engineers. A general engineering background, plus knowledge of airplanes and electronic devices is needed, as well as administrative ability. Former pilot or mechanic experience helpful, but not essential.

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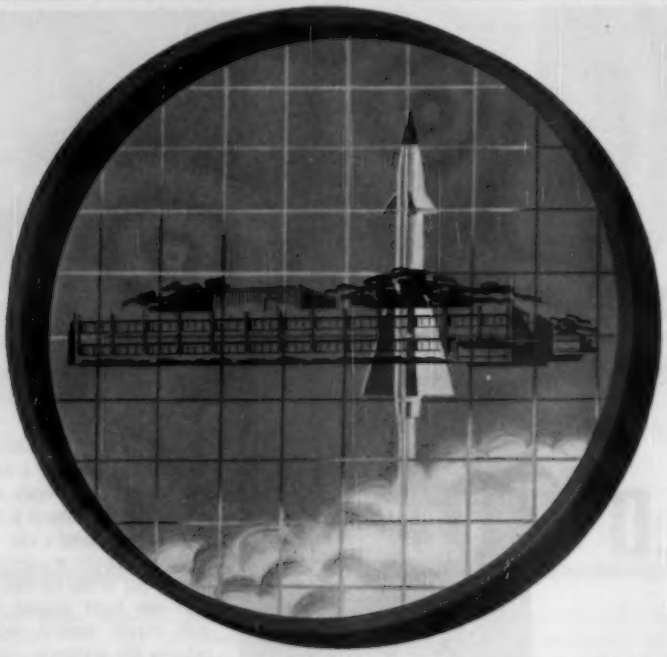

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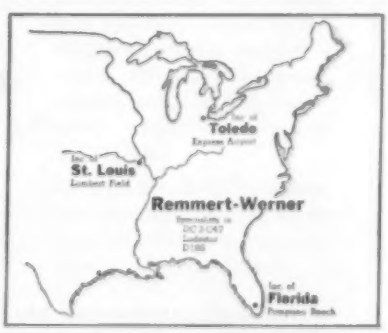

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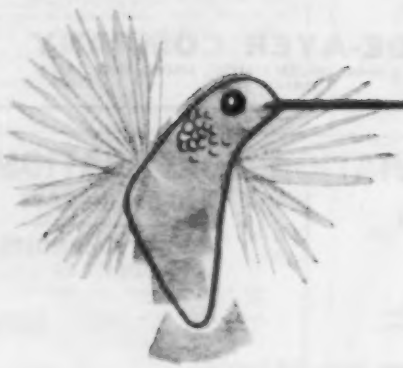

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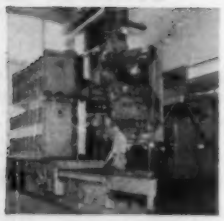

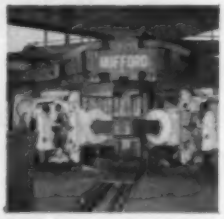

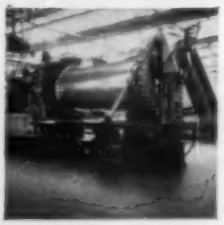

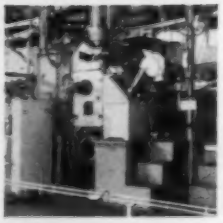

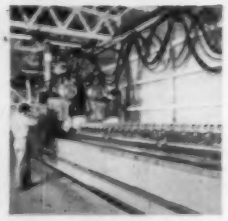

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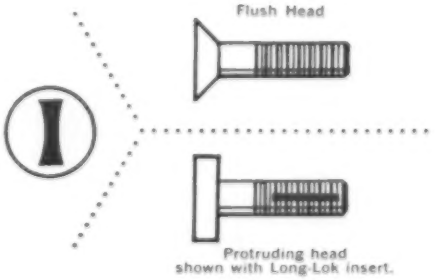

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LETTERS

Time and Language

Re: Mrs. Mara Edwards' letter "Common Language" concerning Esperanto (AW July 14, p. 126).

Since we (pilots, CAA, etc.), are now using United Kingdom time—for some reason CAA wants to know what time it is in England on all our flight plans, reporting points, etc.—I do hope that some responsible party doesn't get wind of Mrs. Edwards' letter, or else we (pilots) will all have to learn Russian or Indian to talk to towers, etc., as they seem to be the countries we are trying to appease now. In an event of an emergency, maybe, if the tower operator will just shake the stick, we will land it all right.

AN AMERICAN READER
San Antonio, Tex.

P. S. I sure do like English and Central Standard Time, and ham and eggs, etc.; hate police action, Communists, etc. I'm an ex-G.I.; high school graduate; major in arithmetic; no foreign languages, though.

High Hats

In reference to the letter from Mr. Bob Arentz (AW July 28, p. 94) concerning the article "Italian Team Pioneers in Formation Landings" (AW May 19, p. 80) and the letter from Lt. Mark Perreault, USN, PIO, Blue Angels (AW June 30, p. 86):

The three aircraft were indeed tied together, but they were not Army fighters. They were the forerunners of today's Blue Angels, Naval Aviation's "High Hats," who thrilled the nation during the Roaring Twenties as they launched a legend for flight precision that still persists. At the 1929 Cleveland Air Races, awed fans watched the trio of Navy Boeing F2Bs as they took off, looped, landed and taxied while tied together by short lengths of manila line.

The Cleveland team consisted of Lt. L. E. Gehres (Rear Adm., ret.), Lt. (j.g.) F. N. Kivette (Rear Adm., ACNO), and Lt. (j.g.) F. O'Beirne (Rear Adm., ComCarDiv Three).

LT. S. E. HARRIS, USMCR
3d Marine Air Wing
MCAS El Toro (Santa Ana), Calif.

Tethered Flying

I have been amused by various stories carried in your recent columns concerning just who made the first formation landings. But when the letter from Mr. Bob Arentz appeared in your July 28 issue (p. 94), in which he recalled some pictures of the 1928-1932ers showing "three single-place Army fighters tied together from takeoff to landing . . .," I thought I'd set the record straight.

Perhaps Mr. Arentz did see some pictures of "Army" planes tied together, but I don't recall the incident during that period. However, I do know that VF-5B, the fighter squadron attached to the old U.S.S. Lexington (sunk in the battle of the Coral Sea), did do this trick at the National Air Races held at Glenview Airport, Chicago, in 1930. One nine-plane division was assigned to this job, with each wing man in each of the three sections having his inboard wing tied to his section leader's wing. (The squadron was there for five days, I believe, leaving for the West Coast the day after Labor Day.) Each day this division took off tied together.

The first two days they also landed in the tied together formation; the rest of the time each section in turn, at the conclusion of its act, dove at the field with the wing men then breaking clear in a pull-up fleur-de-lis.

The airplanes used were the F4B-1 type which were later adopted by the Army Air Corps and designated the P-12.

The landings were pretty tricky. The lines tying the wings together were only 25 ft. long, and it was always necessary to keep them well slacked off. On the second day's landing one section leader overshot his landing point slightly and had to chop his throttle faster than usual. As a consequence one of his wing men overran him, but fortunately without mishap. They didn't land that way again!

I know—I was one of the wing men!

PETER A. WYCKOFF
Comdr. USN, Ret.
Huntington, N. Y.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Dimensional Dilemma

I have just read the letter by Mr. Hugh C. Robbins, president of Robbins Aviation, Inc., in Los Angeles (AW July 21, p. 102). Just as he mentioned about a previous article he was commenting on, his statements "leave me cold." He comments that the "see and be seen" problem of aircraft flying is merely an extension of the same problems encountered in highway traffic. I would like to advance an opposing position with the same example.

The business of avoiding collisions on the highway is essentially a one-dimensional problem. Most of the time the driver need only peer straight ahead, taking in the events in a very narrow arc of vision. Anyone who has done much driving on a large two-dimensional area with no marked traffic lanes can appreciate the drastic increase in difficulties that this additional visual load presents. Here at Fairchild AFB, as at other heavy bomber bases, there are many vehicles operating on the ramps and flight line area, and the problem of keeping watch in all directions for vehicles and moving aircraft presents moments of panic, despite the fact that all traffic moves at less than 25 mph. In fact, enough accidents occurred on wide open ramp areas at this base that it was necessary to limit traffic to marked lanes, reverting to the "one-dimensional" system.

Now, when one leaves the ground in an airplane a third dimension is added and, in addition, the relative closing speeds are increased 10 to 15 times. As can readily be seen, this increases the recognition problem exponentially. The simple mathematics of increasing the area to be observed at a given distance by the third power, and decreasing the time allowed for recognition to one tenth of that experienced in highway travel, points up two appalling facts:

1. Consideration of air traffic problems, consciously or unconsciously, as merely an extension of highway traffic problems (and Mr. Robbins shows that even a supposedly air-minded person can do this) is not only mathematically absurd, but also dangerously short-sighted.

2. Even the relatively simple problems of highway traffic control and accident prevention are, in the opinion of many, out of hand at present. So much more the problems of air traffic control, fantastically more complex, are following the same "dead end" path of having problems increase more rapidly than solutions are found. Perhaps part of the reason for this failure is that those trying to solve the problems are still thinking in one dimension while we are flying in three.

LT. ROBERT D. COLLIER, USAF
Hq. Sq. Sec. 92d Bomb Wing
Fairchild AFB, Wash.

Bells in Oil Hunt

Our personnel have read your article on p. 37 of AVIATION WEEK, Aug. 4, entitled "Vertol 44 Aids In Oil Search." The article is accurate as far as it goes. However, the major portion of what is occurring in the marsh land of Mississippi River's delta has been omitted. On this same job, in addition to the Vertol 44 supplied by Indair, there are two Model 47G-2s provided by Hawk Helicopters. In this respect, we take issue with your statement that the small Bell 47 helicopters have been tried and found wanting. They have been tried and found necessary. Admittedly, they cannot do the job of lifting the seismic drilling rigs and the instrument shack as these items weigh between 2,500 and 3,000 lb. each. However, I think you would find it extremely difficult to run this whole operation with only a Vertol 44. The two Bells are utilized to lay the shot lines, plant the "jugs" and pull the "jugs." In addition, they are utilized to shuttle personnel between the various geographic segments that are being surveyed. We do not wish to detract in any way from the performance of Indair's Vertol operation. It has been and continues to do an excellent job. We feel, however, that the Bell 47G-2s operated by Hawk Helicopters should be given their fair share of the credit.

So far as we know, this is the first all-helicopter seismic survey. If it is successful it should, as you noted, open additional fields for commercial helicopter use.

R. G. ERVIN, JR.
Vice President and Manager
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